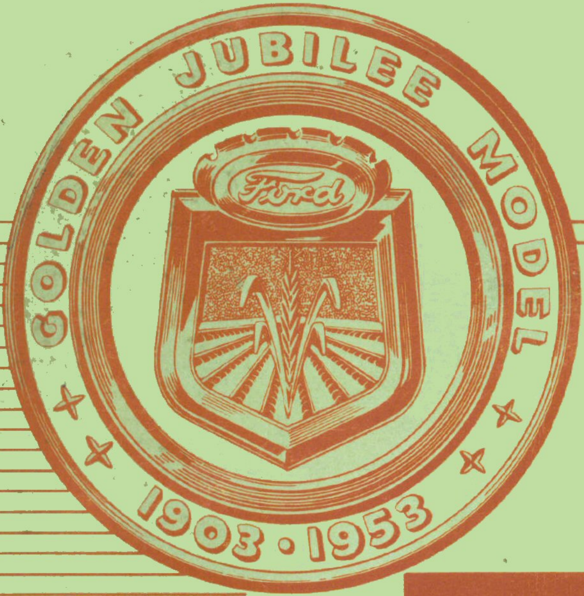
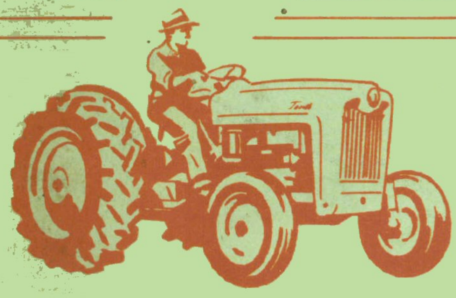
FORD TRACTOR



SERVICE TRAINING MANUAL



Ford
TRACTOR

DEARBORN MOTORS CORPORATION
BIRMINGHAM, MICHIGAN
National Marketing Organization for the Ford Tractor
and Dearborn Farm Equipment

Dearborn
FARM EQUIPMENT

Printed in U. S. A.

Form No. ED-5745-7

INTRODUCTION

This Service Shop Manual gives servicemen all necessary information on the disassembly, assembly, repair, inspection and maintenance of the Engine, Transmission and Hydraulic System of the Golden Jubilee Model Ford Tractor.

An effort has been made to produce a manual that will serve both as a ready reference book for the experienced serviceman and also cover step-by-step procedures to guide less experienced men. It provides the information needed to make repairs and determine engine or other mechanical troubles.

The Manual is divided into Sections. Each Section is further divided into the number of Service Jobs necessary to complete the work. At the beginning of each Section there is an index to the Service Jobs contained in that Section. This arrangement makes the information easy to find and the Manual easy to use.

The Manual should always be kept in a handy place for ready reference. Used properly, it will help all servicemen to serve the owners of the Golden Jubilee Model Ford Tractor quickly and efficiently.

TABLE of CONTENTS

Section I ENGINE

Page

1. Engine Disassembly 1
2. Crankshaft Installation 5
3. Camshaft Installation 8
4. Governor Assembly and Cylinder Front Cover 9
5. Engine Rear Cover Plate, Flywheel and Clutch Assembly 10
6. Piston, Rings and Rod Assembly 11

Page

7. Oil Pump, Pan and Oil Filter 15
8. Cylinder Head Assembly Reconditioning and Installation 16
9. Manifold and Carburetor Assembly Installation 18
10. Water Pump, Fan Assembly and Thermostat Installation 19
11. Ignition System 19

Section II TRANSMISSION

Page

1. Transmission Removal and Installation 23
2. Disassembly and Assembly of the Transmission Cover and Gear Shift Assembly 24
3. Main Drive Gear and Shaft 25

Page

4. Transmission Main Shaft 25
5. Transmission Countershaft 27
6. Reverse Idler Shaft 28
7. Serviving the PTO Shifter Assembly . . 29
8. The PTO Shaft Assembly 30

Section III HYDRAULIC SYSTEM

Page

1. Hydraulic Pump Removal and Disassembly 31
2. Hydraulic Pump Assembly and Installation 33
3. Hydraulic Lift Cover Assembly Removal 34
4. Removal of the Manifold Plate and Valves for the Hydraulic Lift Cover . 35

Page

5. Safety Valve Removal and Installation 36
6. Attaching the Ram Cylinder and Valve Housing to the Lift Cover and Installing the Lift Cover on the Tractor . . 36
7. Constant Draft and Implement Position Control Adjustments 37

NAA Engine Specifications . . . 39, 40, 41 and 42

Section I

ENGINE

Section I

ENGINE

Service Job No. **Page**

1. Engine Disassembly 1
2. Crankshaft Installation 5
3. Camshaft Installation 8
4. Governor Assembly and Cylinder Front Cover 9
5. Engine Adaptor Plate, Flywheel and Clutch Assembly . . 10
6. Piston, Rings and Rod Assembly 11
7. Oil Pump, Pan and Oil Filter 15
8. Cylinder Head Assembly Reconditioning and Installation . 16
9. Manifold and Carburetor Assembly Installation . . . 18
10. Water Pump, Fan Assembly and Thermostat Installation . 19
11. Ignition System 19

Service Job No. 1.

ENGINE DISASSEMBLY

Disassembly is a major step in the overhaul of a tractor engine. Procedures which are followed in performing this step have a direct bearing on the quality of work and the results obtained when the engine is put back into operation. The following procedure is recommended for the efficient and workmanlike disassembly of the Golden Jubilee Model Ford Tractor engine.

PROCEDURE

A. Prepare Tractor For Removing The Engine.

1. Clean the cooling system thoroughly.

   NOTE: If this is not done, sediment in the system will dry, become hardened and thereby affect cooling efficiency when the engine is reassembled.

2. Drain cooling system and oil pan.
3. Remove the hood assembly and fuel tank assembly.
4. Clean outside of engine thoroughly.

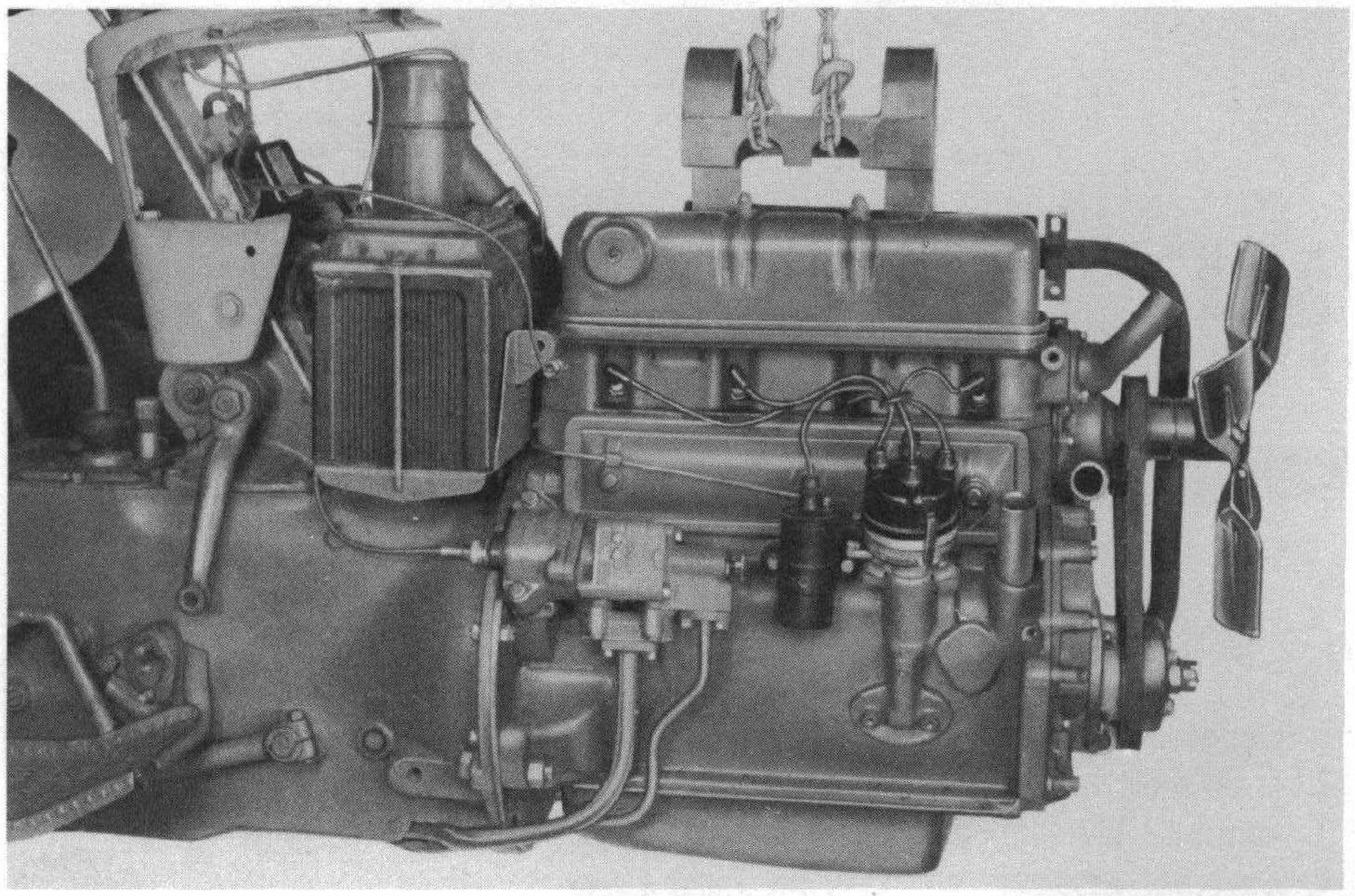


Fig. 1

B. Remove Engine From The Tractor.

NOTE: Local service shop procedures will determine whether this step is carried out in overhauling an engine.

1. Attach engine lifting hook to cylinder head and support weight of engine with chain fall. (Figure 1)
2. Place jack or floor stand under tractor transmission housing.
3. Remove front axle and radiator assemblies from the engine by:
   a. Disconnecting radius rods and drag links at the rear.
   b. Removing four (4) nuts that secure axle support assembly to block.
4. Disconnect and free from engine assembly—choke linkage at the carburetor end, the wire from the coil, the cable from the negative post of the battery, the heat indicator element from the cylinder head and the three wires from the generator.
5. Disconnect and remove all governor and carburetor linkage.

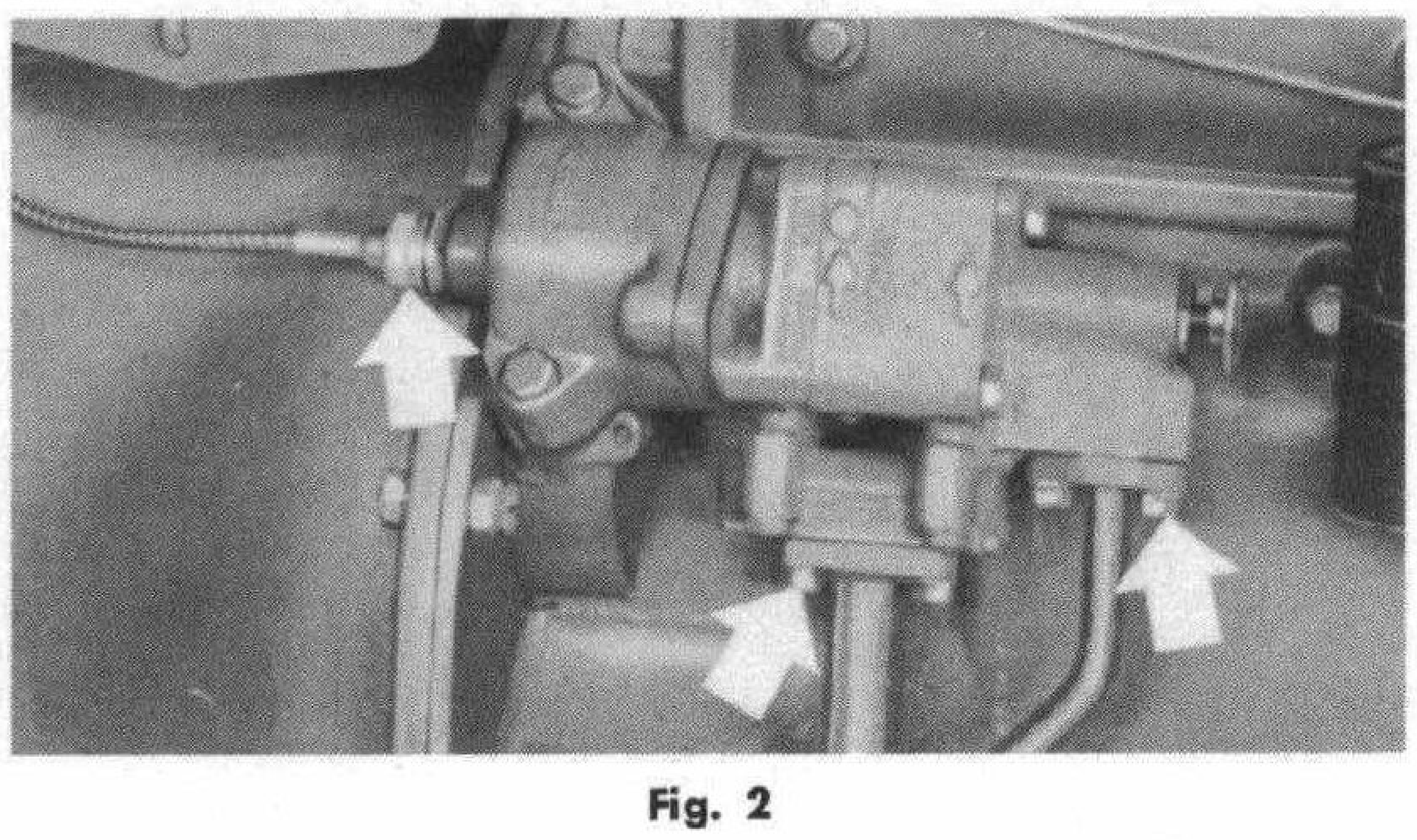


Fig. 2

6. Disconnect and remove oil gauge line.
7. Disconnect hydraulic lines and Proof-Meter cable from pump and remove pump from engine. (Figure 2)
8. Remove oil filter.
9. Remove starter.
10. Remove bolts securing engine to transmission case and free the engine from the tractor.

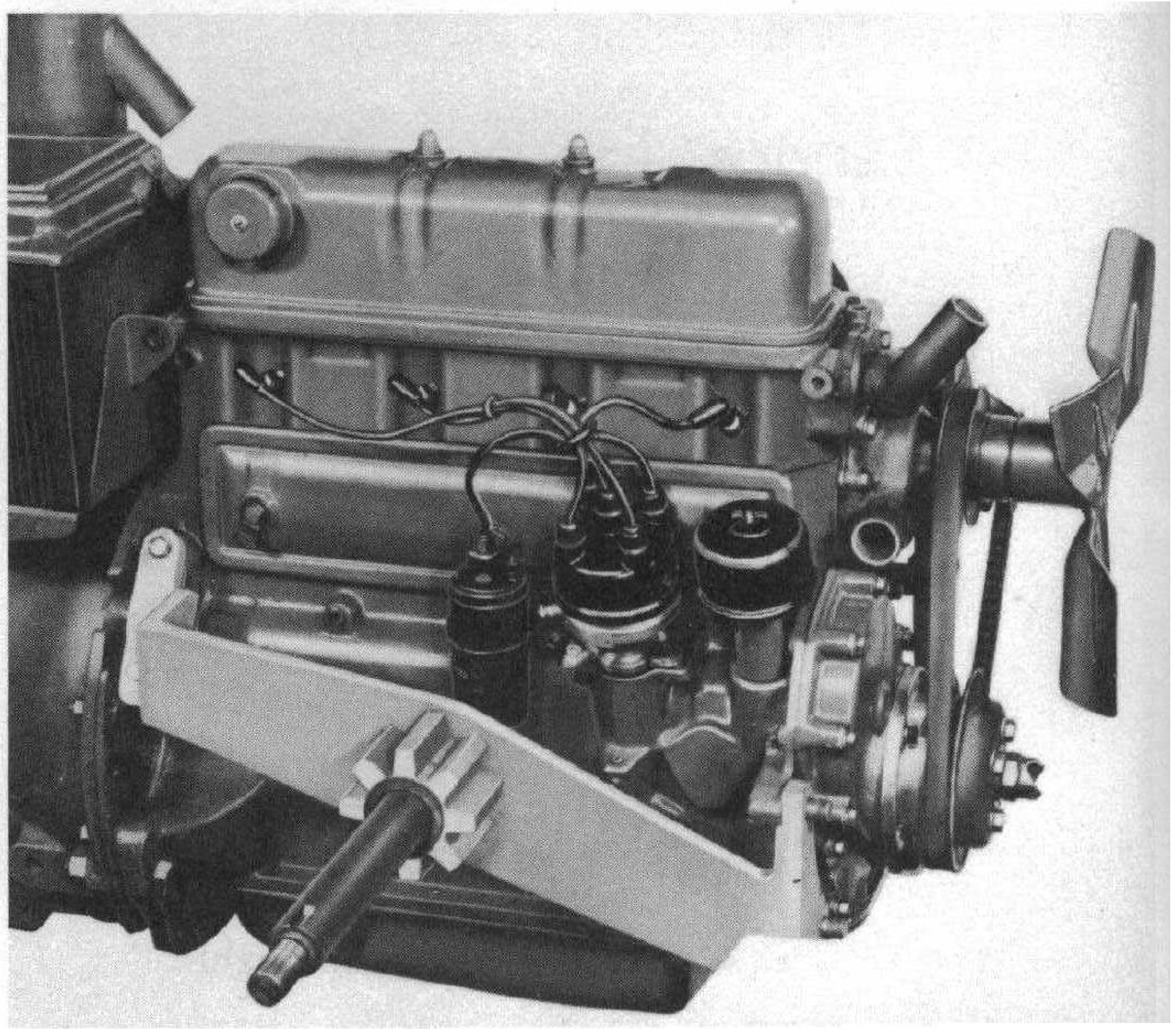


Fig. 3

11. Mount engine on engine stand. Use engine stand adaptor to secure engine to stand. (Figure 3)
12. Remove lifting hook from cylinder head.

C. Disassemble The Engine.

1. Remove the manifold and carburetor assembly.

   NOTE: The manifold should be cold. A hot manifold tends to warp when removed.

2. Remove the generator, fan belt and water pump from the engine.
3. Remove ignition wire from the spark plugs and the primary wire from the distributor.
4. Remove the distributor, coil and spark plugs from the engine.
5. Remove the valve push rod cover.

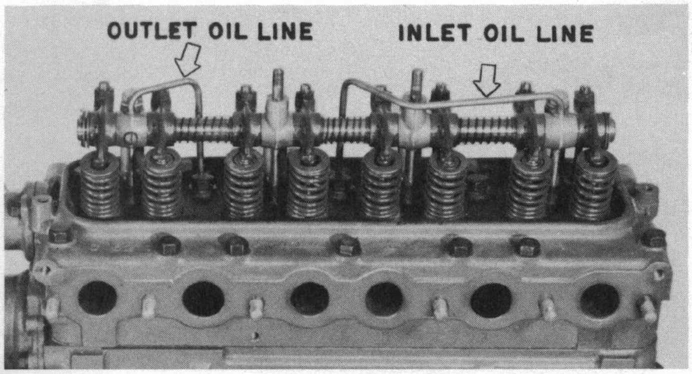


Fig. 4

6. Remove the rocker arm cover and the oil inlet and outlet lines. (Figure 4)
7. Remove push rods from cylinder block.
8. Remove cylinder head bolts and attach tool. Remove the cylinder head from engine block. (Figure 5)

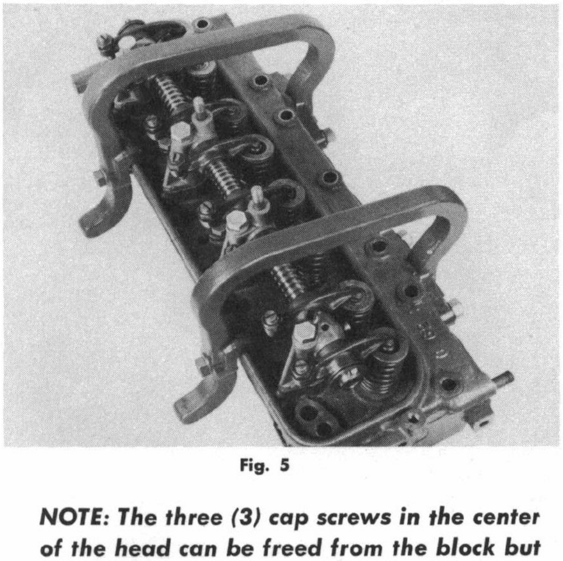


Fig. 5

NOTE: The three (3) cap screws in the center of the head can be freed from the block but cannot be removed from head because of the rocker arm support shaft.

9. Remove the governor and front cover by:
   a. Removing crank ratchet nut and pulley from crankshaft.
   b. Removing governor housing from front cover.
   c. Removing governor ball and race assembly from crankshaft.
   d. Removing front cover from cylinder block.
10. Rotate the engine on stand to inverted position.
11. Remove the oil pan from the block.
12. Remove the oil filter inlet tube. (Figure 6)
13. Remove the clutch and flywheel from the crankshaft and the adaptor plate from the engine.

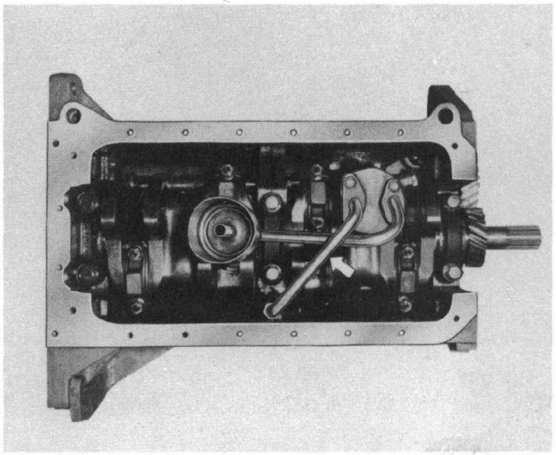


Fig. 6

14. Remove the camshaft and hydraulic pump drive gear assemblies from the block by:
    a. Removing the access plate from rear face of engine block. (Figure 7)

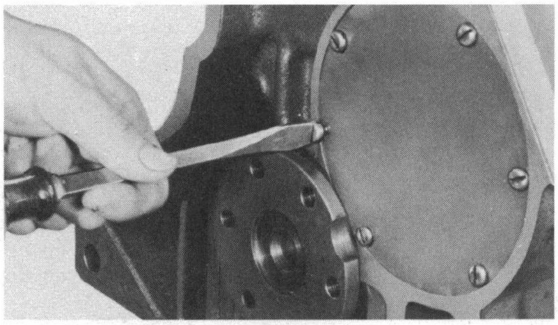


Fig. 7

b. Removing the hydraulic pump drive gear from the camshaft.

c. Removing the camshaft thrust plate from front of cylinder block. Rotate gear to get at the two (2) cap screws which hold the plate. (Figure 8)

d. Pulling camshaft from engine block. Work carefully to avoid damaging bearing surfaces.

e. Removing gear and thrust plate from front of camshaft.

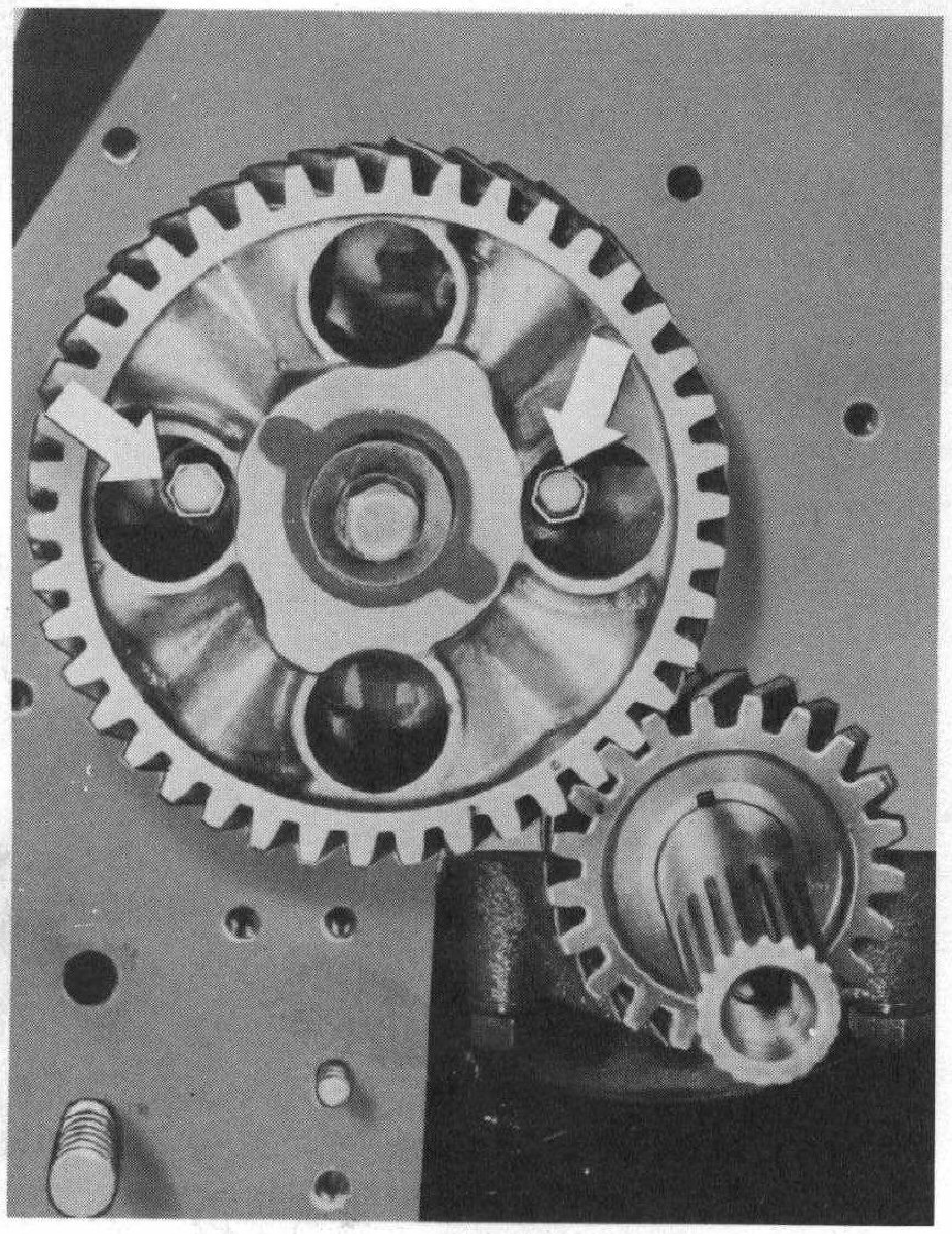


Fig. 8

15. Remove the connecting rod and piston assembly No. 1 first, No. 2 second, etc., keeping component parts of each assembly together.

NOTE: Remove ridge from top of cylinder bore before pushing piston out of cylinder. (Figure 9) In freeing connecting rods from the crankshaft, be sure the respective bearing liners remain with each connecting rod assembly.

16. Remove the oil pump from the block by:

a. Removing oil pump tube and cover assembly.

b. Removing the two (2) oil pump gears.

c. Removing the two (2) nuts that secure it to the block.

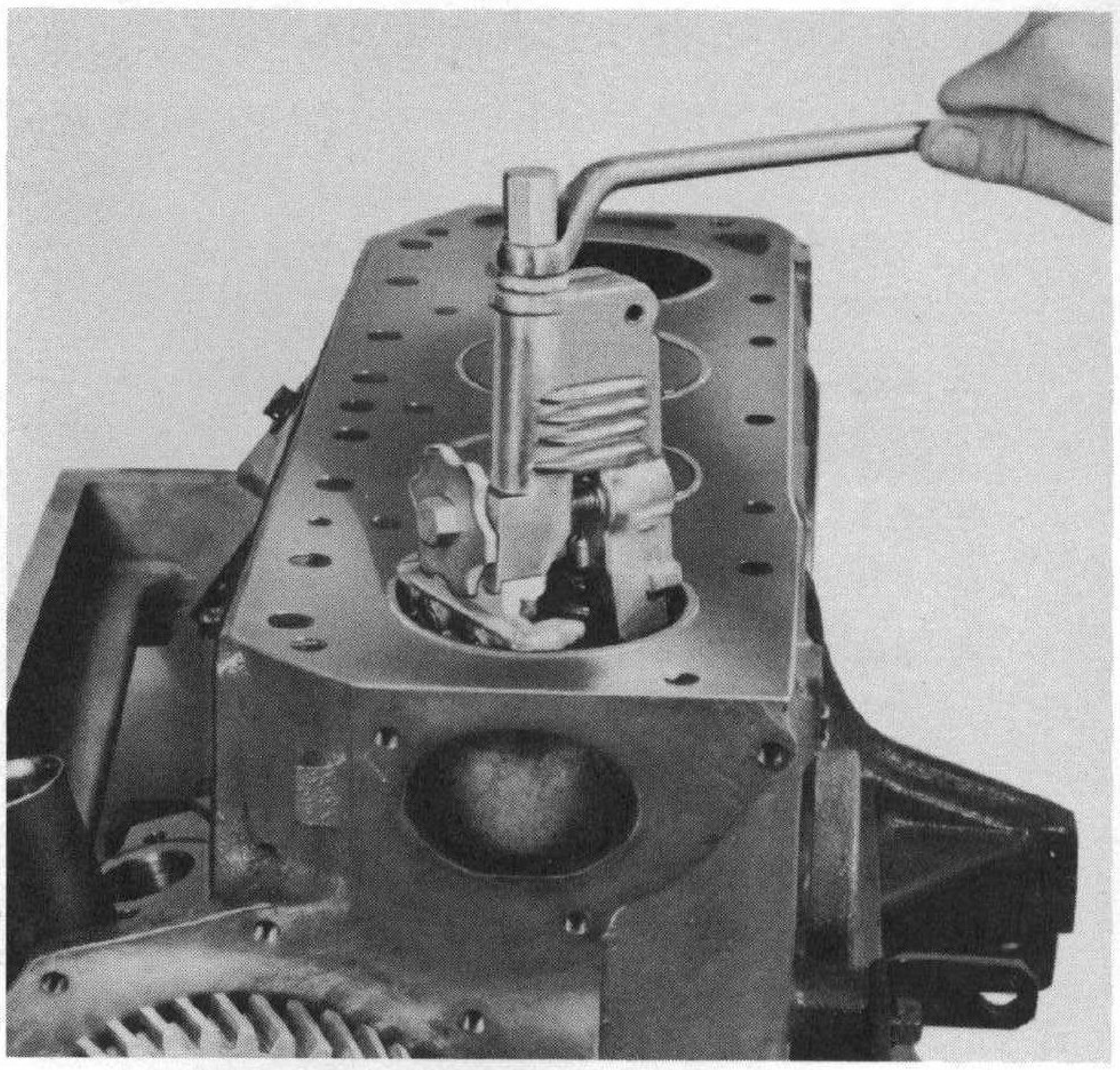


Fig. 9

17. Remove the main bearing caps and liners in sequence No. 1, No. 2, etc.

NOTE: Keep the front and rear bearing liners with their respective caps.

18. Remove the crankshaft, upper liners and oil seal from block.

19. Remove the gear from the crankshaft, using special puller. (Figure 10)

20. Remove the valve tappets from the block.

NOTE: Identify each tappet so that it can be returned to its original bore.

21. Clean all parts to facilitate inspection and handling.

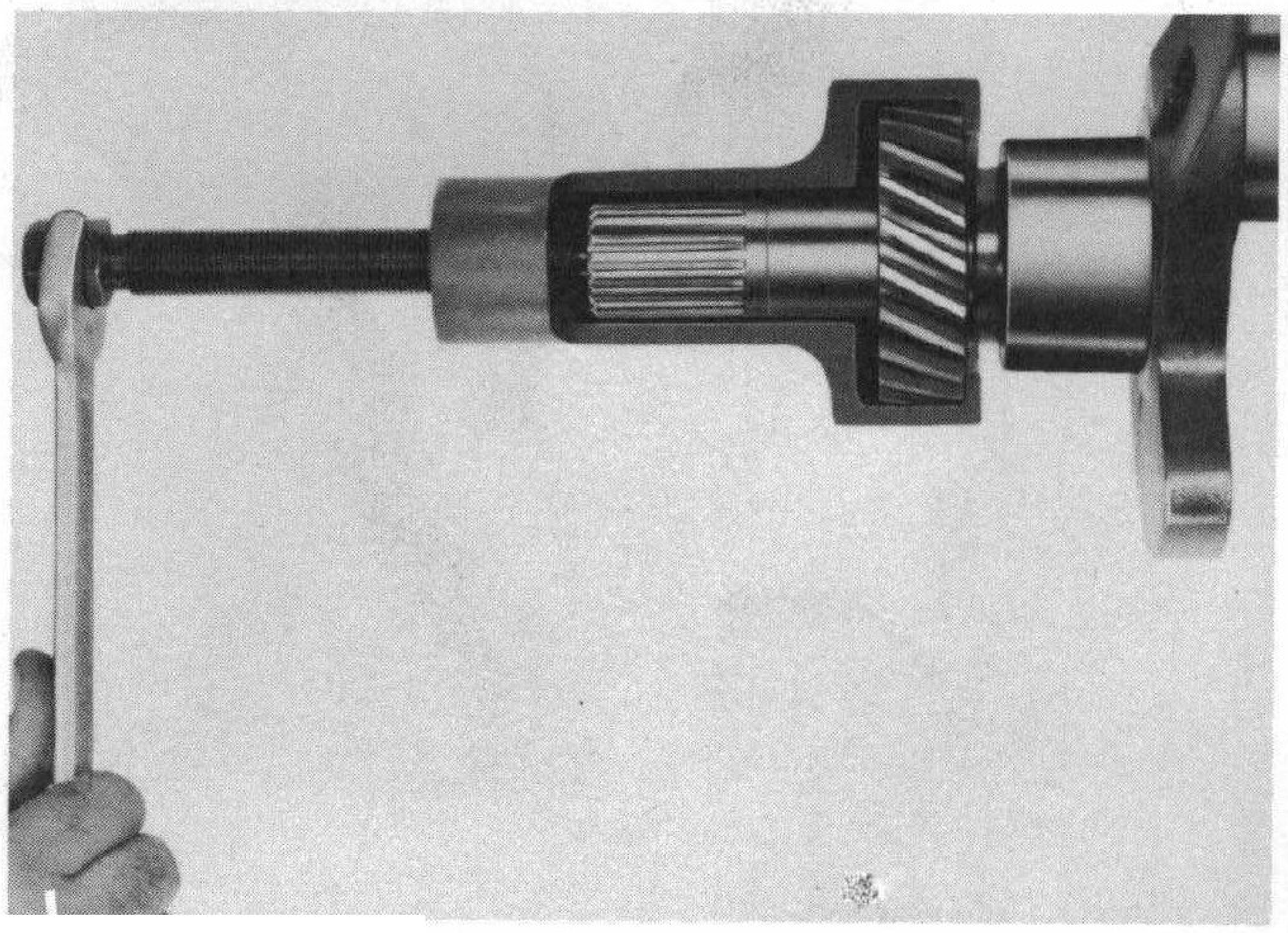


Fig. 10

Service Job No. 2.

CRANKSHAFT INSTALLATION

The crankshaft is dynamically balanced with three extra large main bearings and eight counter weights. The material is cast alloy iron, carefully heat-treated. The shaft weighs 53½ pounds. Oil passages in the crankshaft direct oil flow to main and connecting rod bearings. Crank thrust is taken on the center main bearing. Proper installation of the crankshaft requires following a definite plan and careful workmanship in order to attain required specifications. In the first place, the crankshaft and block must be thoroughly cleaned and free from all foreign material.

The bearing journals should be checked with the micrometer for taper and out-of-round. If the taper exceeds .0005 inch or an out-of-round condition exceeds .00025 inch, the crankshaft journal must be ground to the next undersize.

Inspect the shaft for evidence of cracks. These cracks, when they exist, are usually found in the fillet or radii of the bearing journals. Inspect the main bearing liners for any galled or pitted condition, or babbitt missing from the steel back. If any of these conditions exist, the bearing liner must be replaced.

PROCEDURE

1. Mount the gear on the front end of the crankshaft, using special tool. (Figure 11)

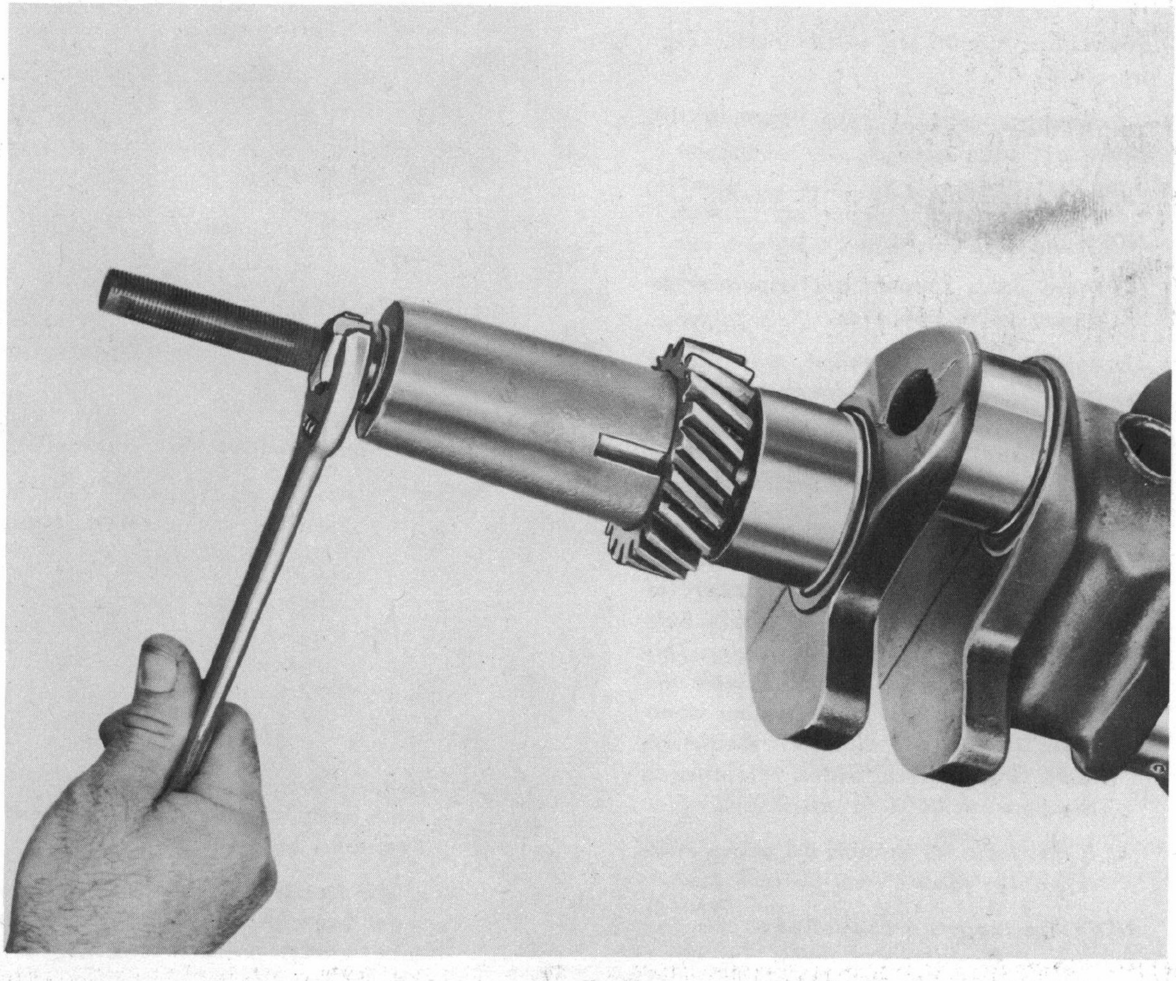


Fig. 11

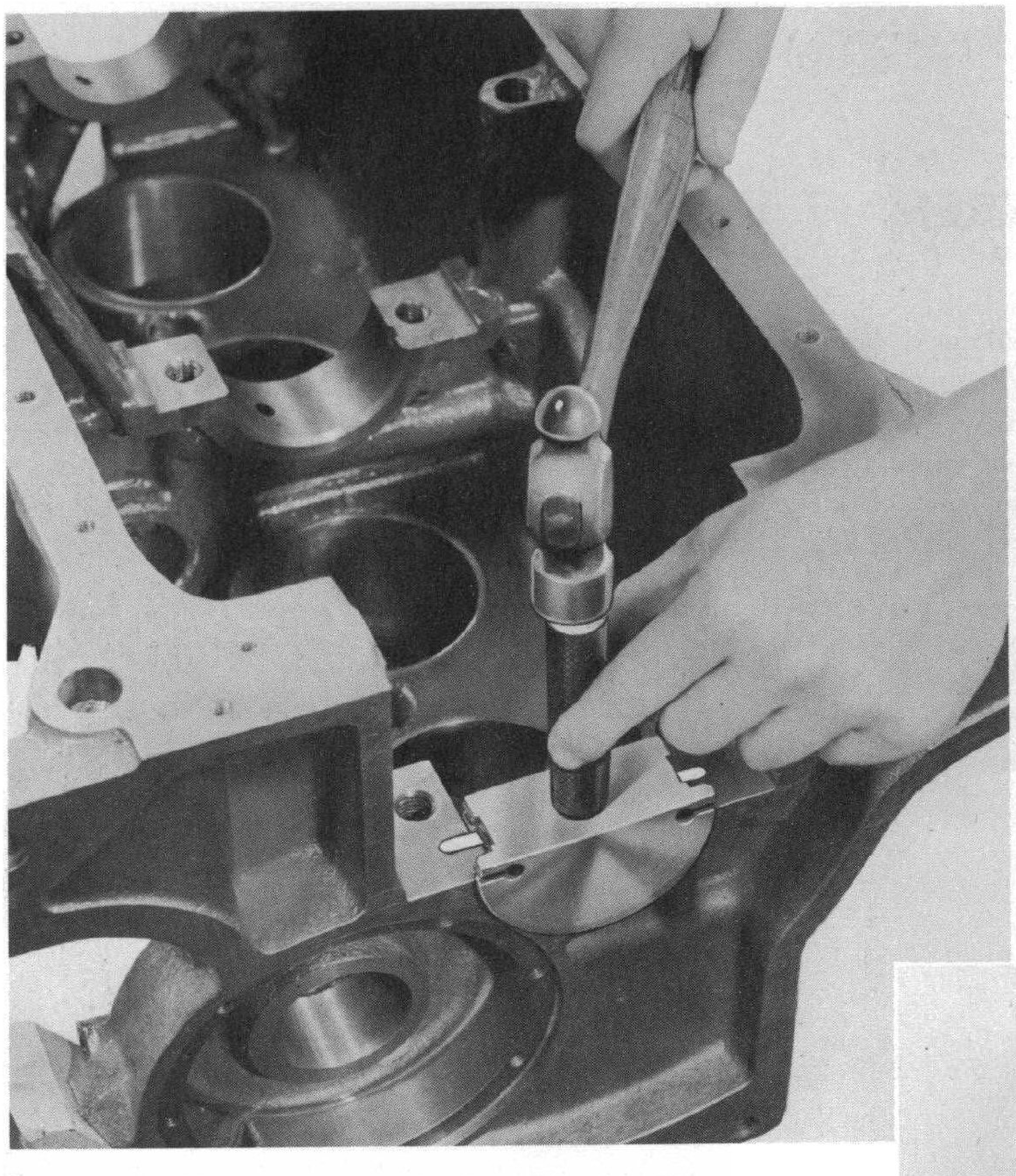


Fig. 12

2. Replace the rear oil seal in the block. (Figure 12)
3. Install upper main bearing liners in the block.
4. Fit valve tappets in place in the block.

NOTE:

(1) These valve tappets are important to proper valve operation.

(2) Before they are installed, they should be carefully inspected for any galled or rough surfaces because any roughness will cause erratic valve operation. If this condition exists, the tappet must be replaced.

(3) The valve tappet bore diameter in the cylinder block should be checked for proper clearance with a small hole gauge and an outside micrometer. This dimension is then compared with the O.D. of the tappet to determine clearance. The tappet diameter should be .4990 to .4995 inch, with a clearance to the bore of .0005 to .0020 inch.

(4) If the clearance exceeds the above maximum, the tappet must be replaced.

NOTE: The tappets are installed at this time because it is easier than after the crankshaft is in place.

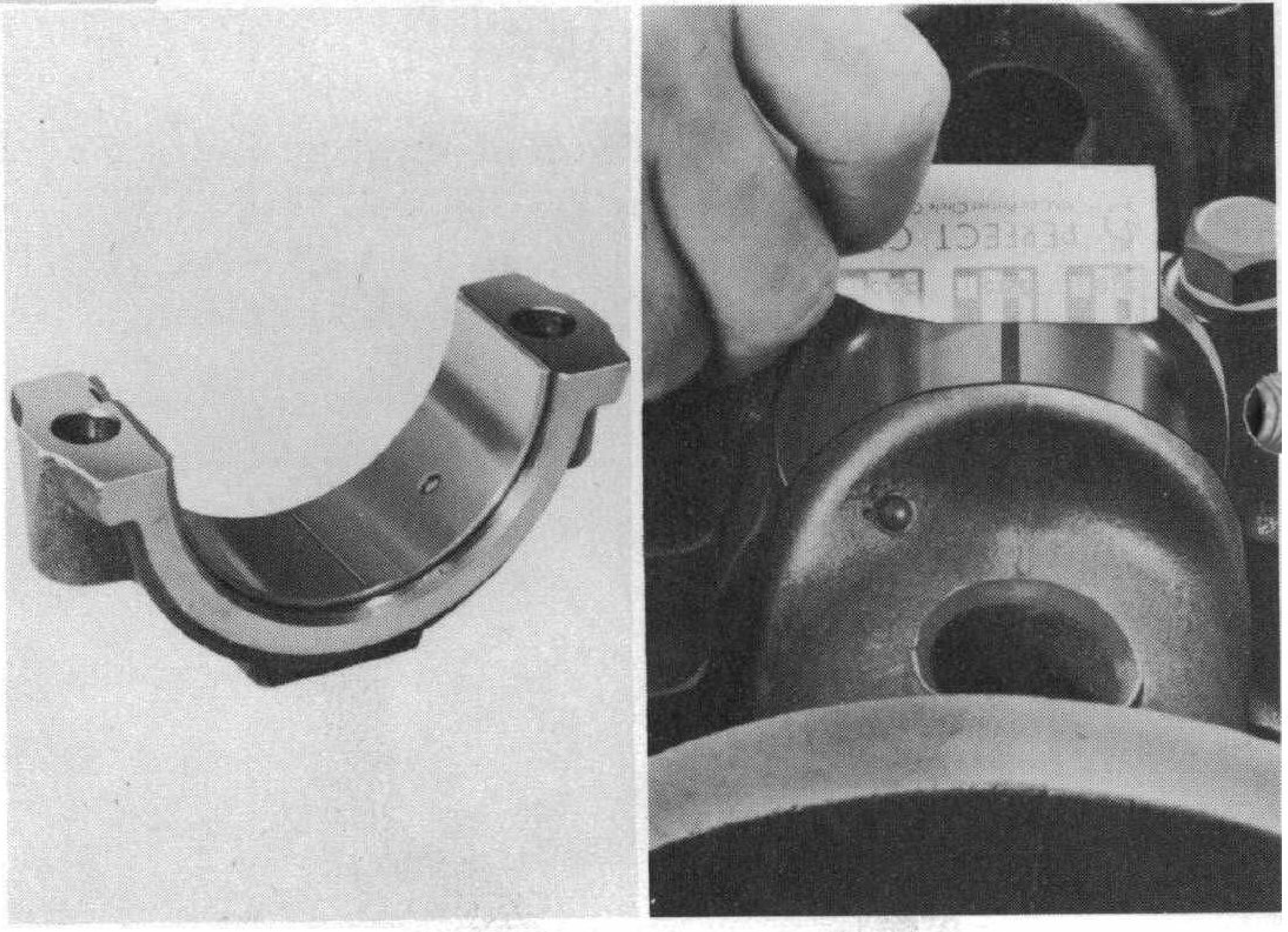


Fig. 13

5. Place the crankshaft in position in the block.
6. Place a piece of Plastigage on each main journal, fit bearing caps in place and torque to 95 to 105 foot-pounds.
7. Remove the bearing caps and check Plastigage to determine bearing clearance. (Figure 13) Specifications are .0007 to .0023 inch clearance.

NOTE:

(1) If the bearing clearance exceeds maximum limits, the next undersize bearing liner must be used.

(2) If the bearing clearance exceeds minimum limits, the crankshaft journal must be ground to the next undersize, or the crankshaft must be replaced.

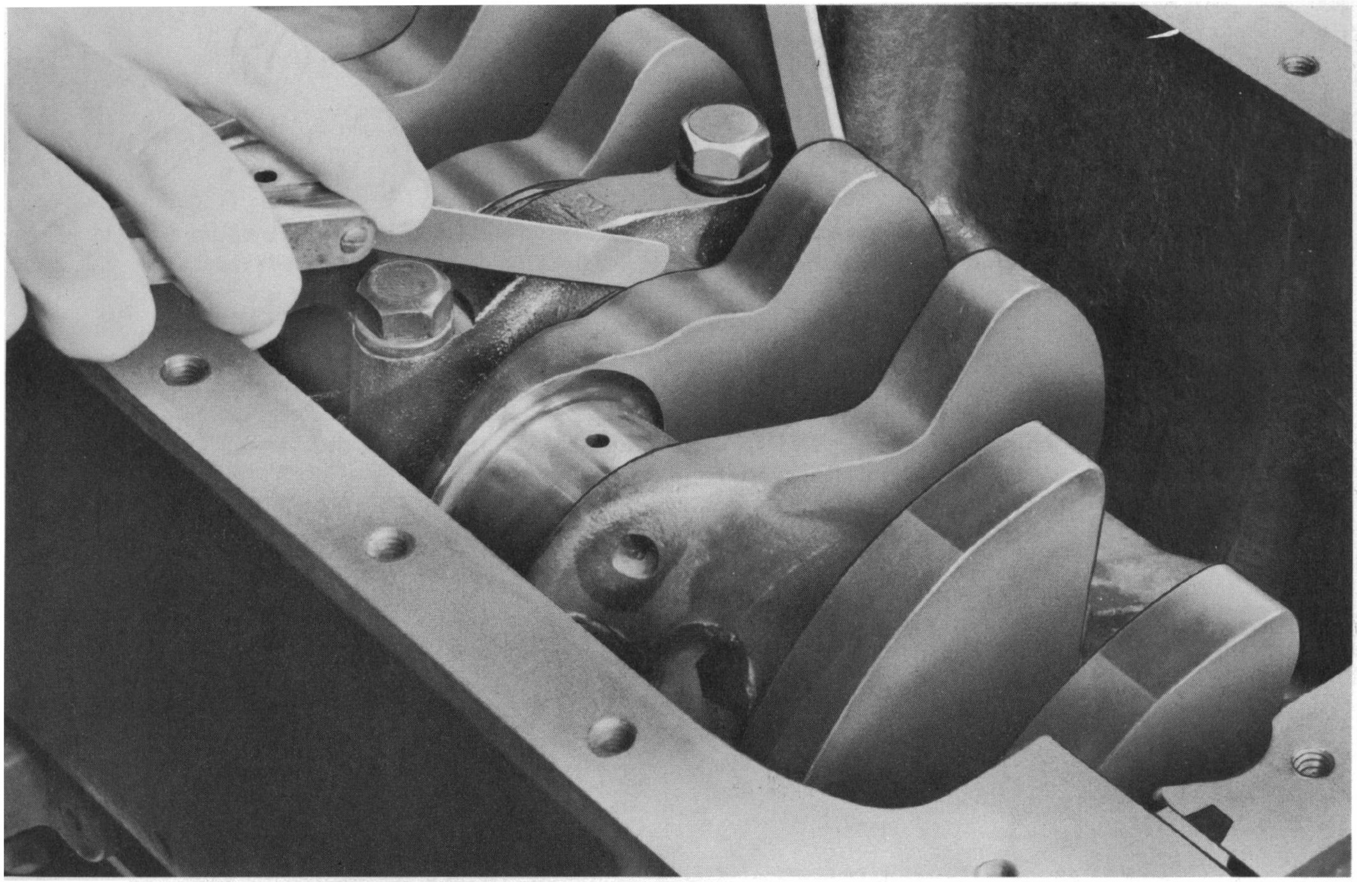


Fig. 14

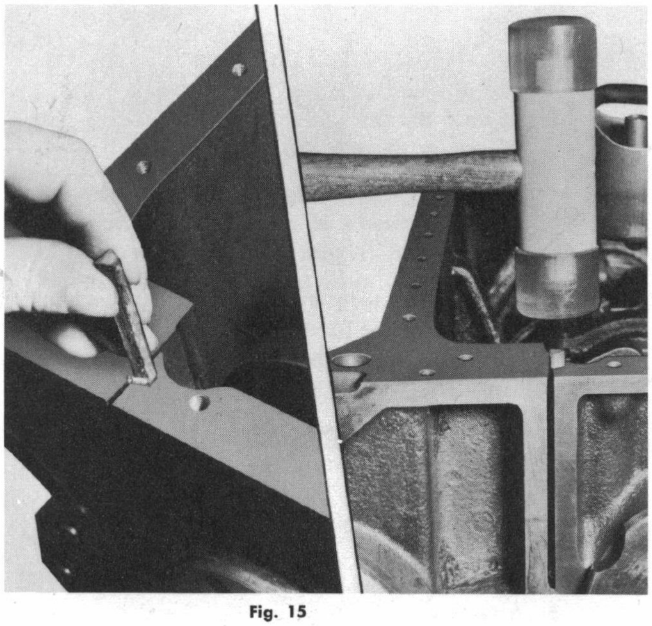


Fig. 15

8. When the proper bearing clearance is attained and the bearing caps are properly torqued, check the crankshaft end play by moving the crankshaft toward the rear of the engine. (Figure 14) Specifications are .002 to .006 inch.

NOTE:

(1) If the clearance exceeds maximum limits, the center main bearing must be replaced.

(2) If the clearance exceeds minimum limits, the center main bearing must be replaced.

9. Install new oil seals by:

a. Dipping seal in oil and pressing in rear main bearing recess as far as possible. (Figure 15)

b. Gently tapping oil seal with small hammer until flush with rear main bearing cap. (Figure 15)

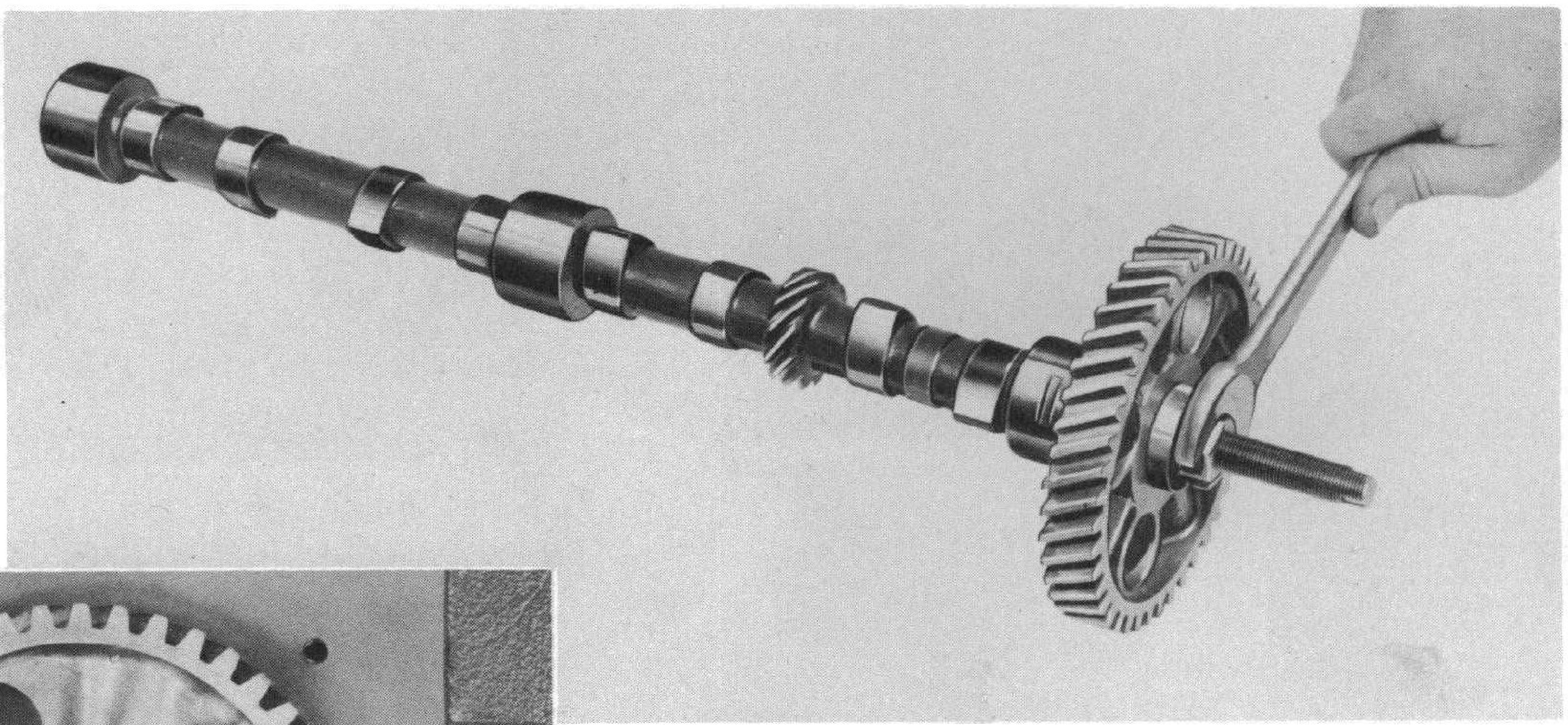
NOTE: The seal should be inserted immediately after dipping due to rapid expansion.

Service Job No. 3.

CAMSHAFT INSTALLATION

The camshaft is made of high-grade cast alloy iron with three large bearing surfaces and is of the high lift type incorporating an integral helical gear which drives the distributor. Camshaft thrust is controlled by a thrust plate attached to the front of the cylinder block. The drive gear is a press fit with a key to the shaft. Before installing the camshaft, a definite plan of inspection must be followed to attain proper valve operation. The shaft must be thoroughly cleaned and free from all foreign material. The bearing surfaces should be checked with a telescope gauge and micrometer to determine if the following specified clearance exists. The block bore diameter is 1.9275 to 1.9285 inch. The camshaft journal diameter is 1.9255 to 1.9265 inch. The bearing clearance should be .0015 to .003 inch. Lobes should be inspected for worn or pitted condition.

Fig. 16



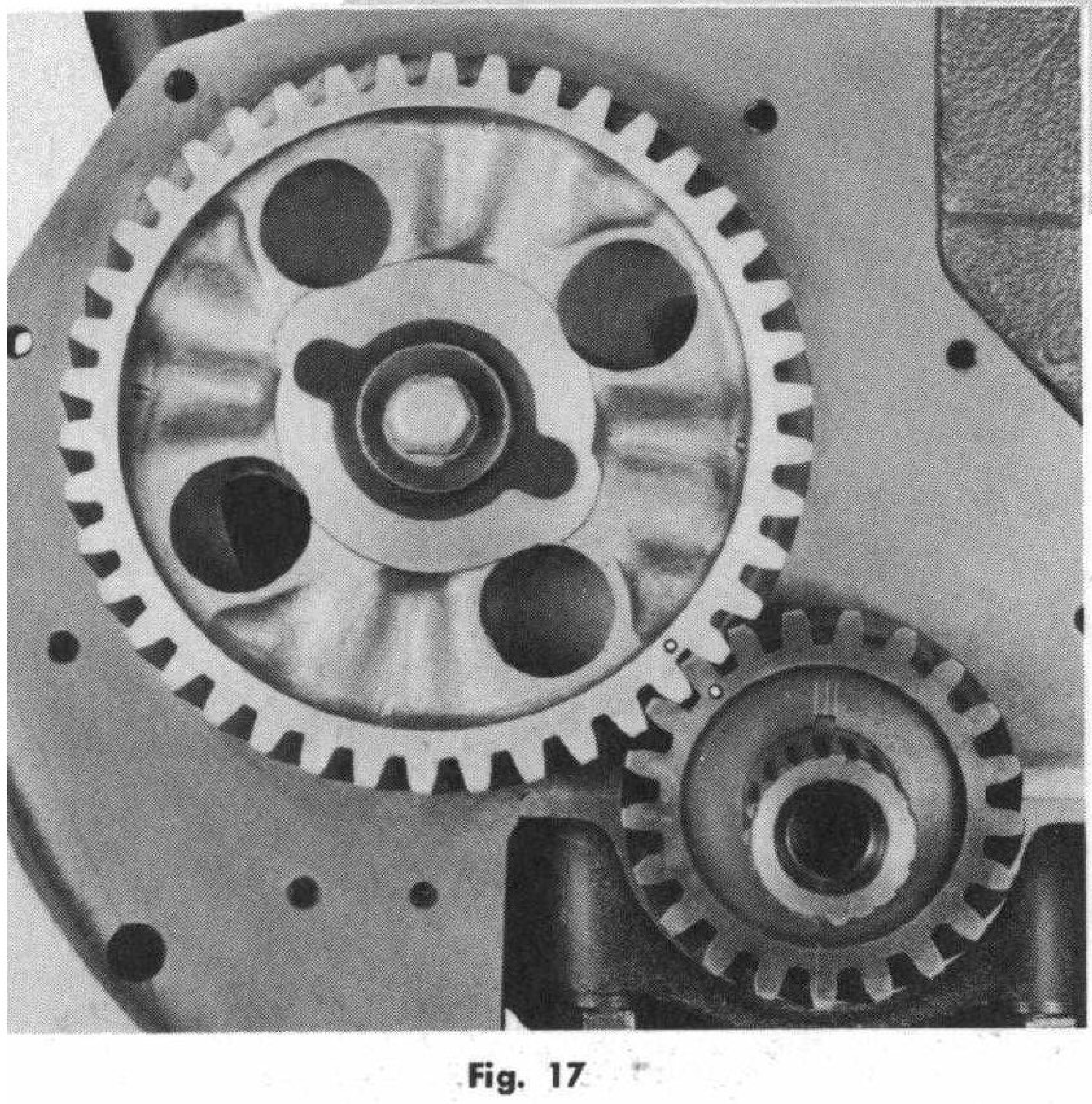


Fig. 17

PROCEDURE

1. Place thrust plate on front end of camshaft and press gear on using special tool. (Figure 16)
2. Replace the camshaft in the block being careful not to damage bearing surfaces.

   NOTE: When engaging camshaft, be sure to align marks of camshaft gear to crankshaft gear. (Figure 17)

3. Tighten and torque the two (2) thrust plate cap screws to 10 to 15 ft. lbs. and replace cap screw and lock washer in front end of camshaft.
4. Install hydraulic pump drive gear to rear end of camshaft, torquing the cap screws to 12 to 16 ft. lbs.

   NOTE: Line up oil holes in rear journal and drive gear.

5. Attach gasket and hydraulic pump drive gear access plate to cylinder block.

Service Job No. 4.

GOVERNOR ASSEMBLY AND CYLINDER FRONT COVER

The governor base and cylinder front cover is a casting. The governor is of the centrifugal type incorporating six steel balls, each with a diameter of ¾ inch. Its effective speed control range is from 800 r.p.m. to 2200 r.p.m.

Two needle type bearings are incorporated into the governor case for smooth governor shaft operation and are sealed by a Welsh plug and an oil seal.

DISASSEMBLY PROCEDURE

1. The governor ball and race assembly is disassembled by removing the two (2) snap rings with snap ring remover.
2. Remove governor fork from lever assembly.

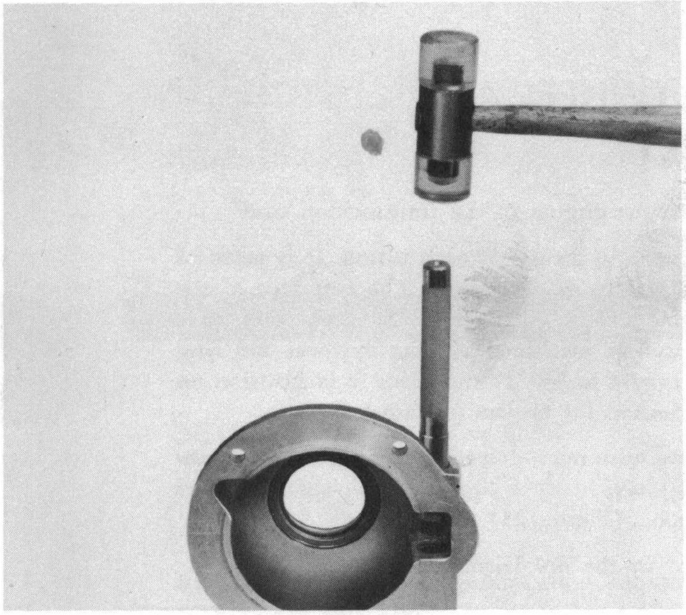


Fig. 18

3. Remove Welsh plug, two (2) needle bearing assemblies and oil seal from case with special tool. (Figure 18)
4. Remove crankshaft seal.

INSPECTION PROCEDURE

1. Inspect needle bearing assemblies for loose needles and excessive clearance to lever assembly shaft.

   If either of these conditions exists it will be necessary to replace bearings.
2. Check ball race assembly for wear, pits and scoring. If parts are found with any of these conditions, they must be replaced for proper governor operation.

ASSEMBLY PROCEDURE

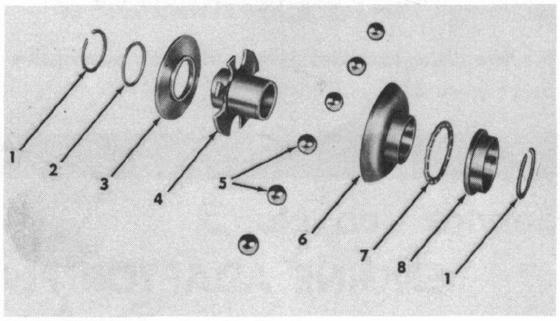


Fig. 19

1. Snap Ring
2. Thrust Washer
3. Lower Race
4. Centrifugal Assembly
5. Balls
6. Upper Race
7. Thrust Bearing
8. Spindle and Sleeve Assembly

1. Assemble governor ball and race assembly. (Figure 19)
2. Install crankshaft seal with special tool. (Figure 20)

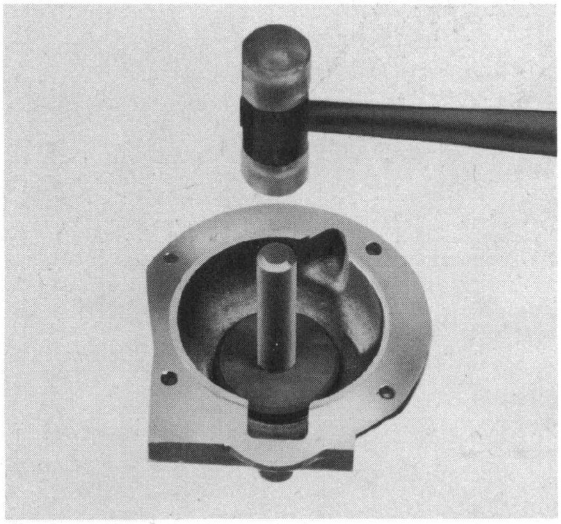


Fig. 20

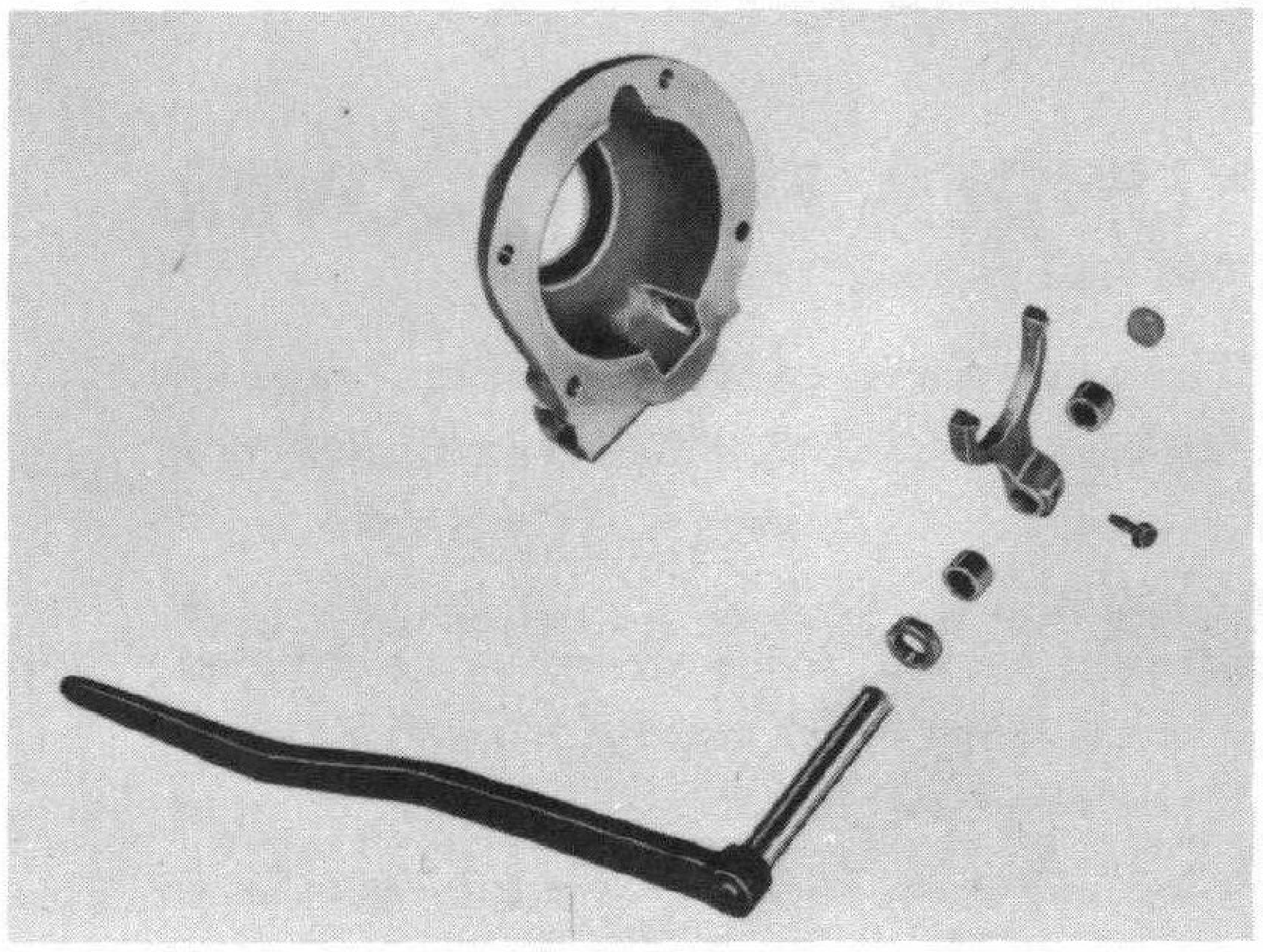


Fig. 21

3. Assemble governor base and lever assemblies. (Figure 21)

INSTALLATION PROCEDURE

1. Install cylinder front cover, torquing cap screws to 15 to 18 ft. lbs.
2. Place ball and race assembly on crankshaft.
3. Install governor case to front cover, torquing cap screws to 6 to 10 ft. lbs.
4. Install crankshaft pulley assembly and tighten crankshaft ratchet nut.

Service Job No. 5.

ENGINE ADAPTOR PLATE, FLYWHEEL AND CLUTCH ASSEMBLY

The adaptor plate is made of steel and is used to attach the engine to the transmission case.

The flywheel acts to carry over and smooth out the separate thrusts of each piston. It is made of cast iron with a shrunk-on steel gear and has a total weight of 52 pounds. The rear face of the flywheel is used as a friction surface which is engaged by the clutch plate. Flywheels that have burned or scored friction face surface should be replaced or machined. Inspect flywheel and ring gear for cracks. To replace ring gear, heat new ring evenly to 360°F. and place it in position on the flywheel and allow to cool. Ring gear should be checked for broken or damaged teeth.

The clutch pilot bearing should be checked for clearance with main drive shaft, this clearance must not exceed .0011 inch. If clearance exceeds this limit remove pilot bearing with special puller (Figure 22) and replace new bearing with special tool. (Figure 23)

The clutch is a single plate type. It is the same as used in the 8N Ford Tractor.

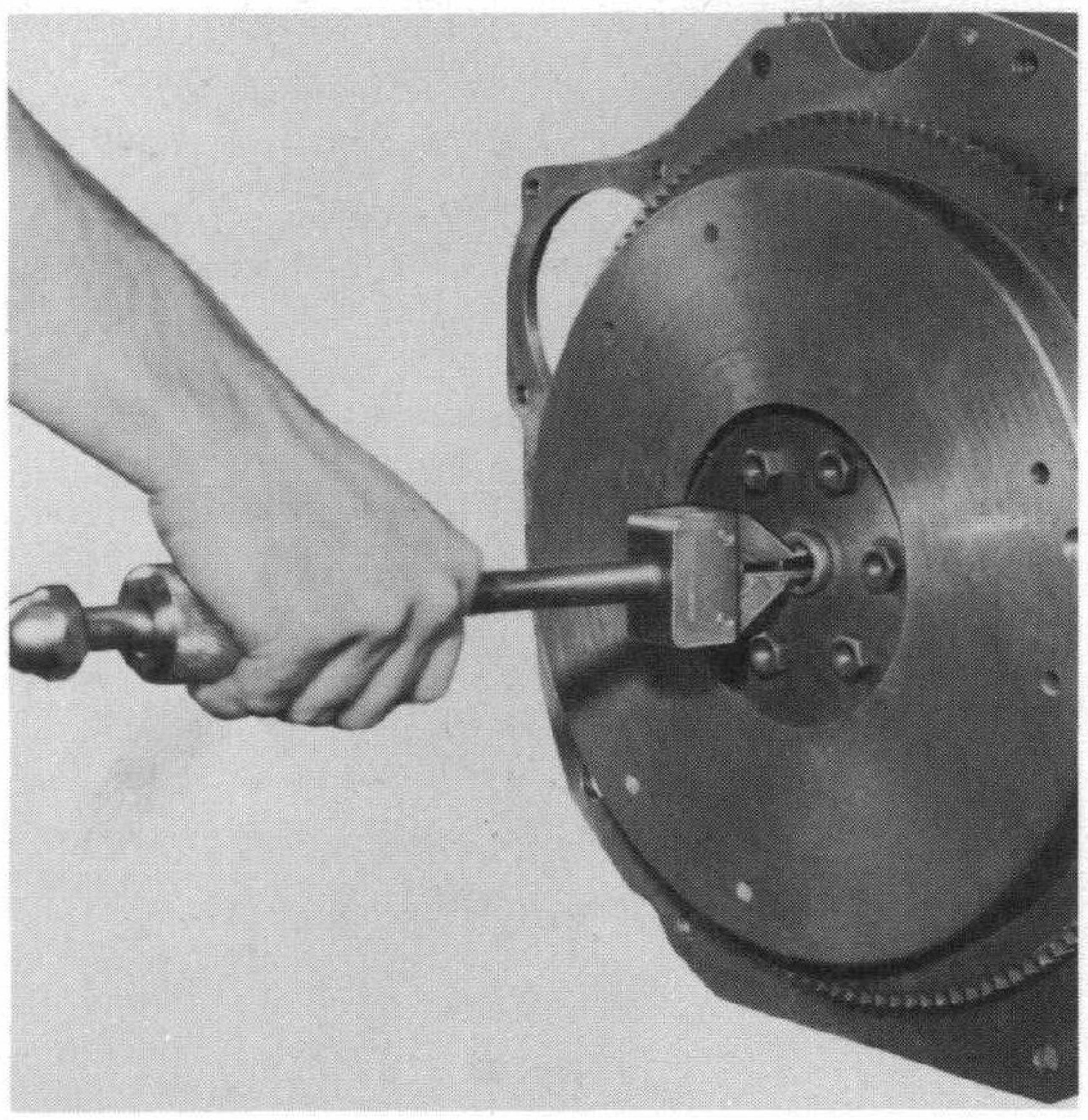


Fig. 22

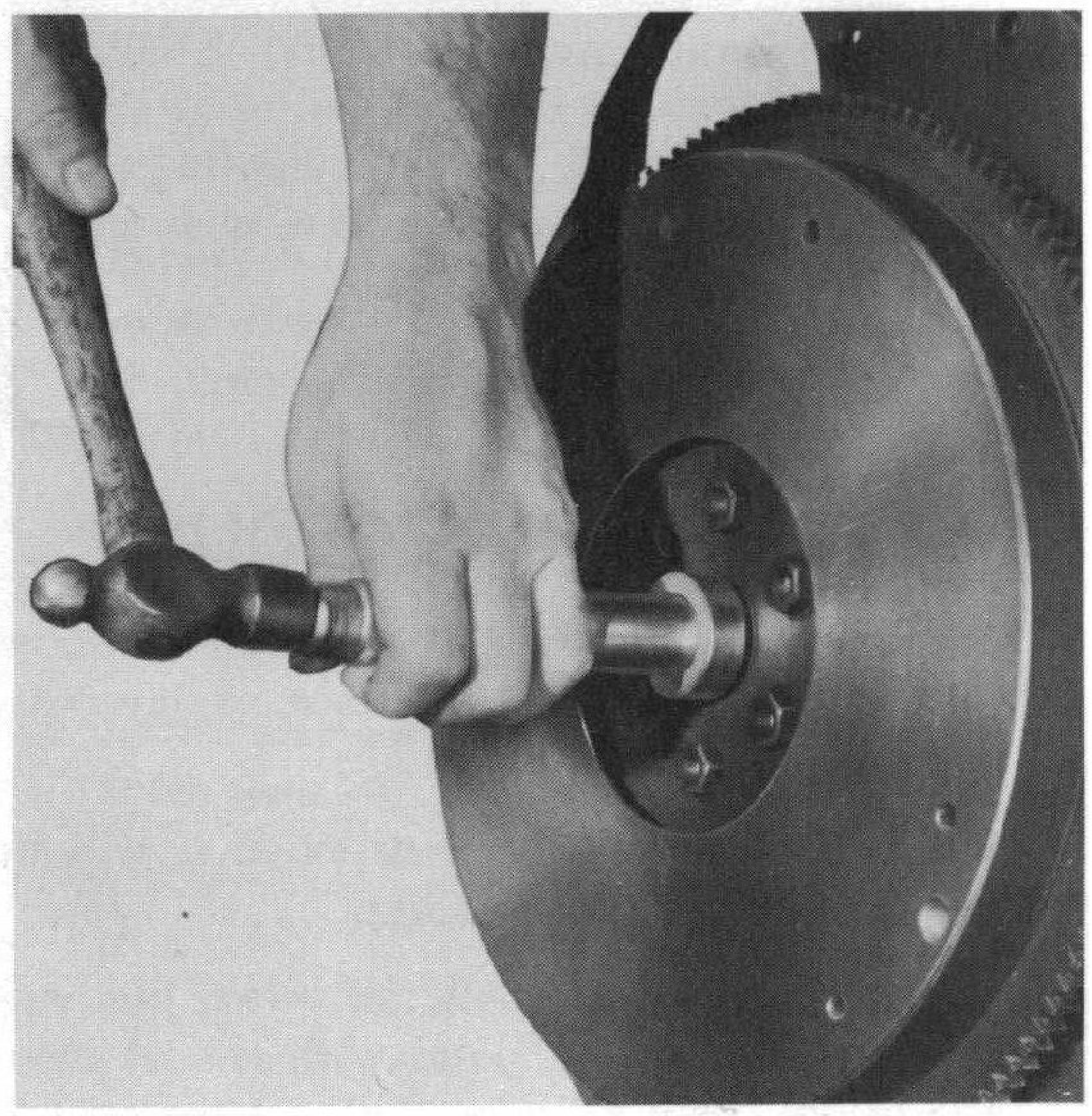


Fig. 23

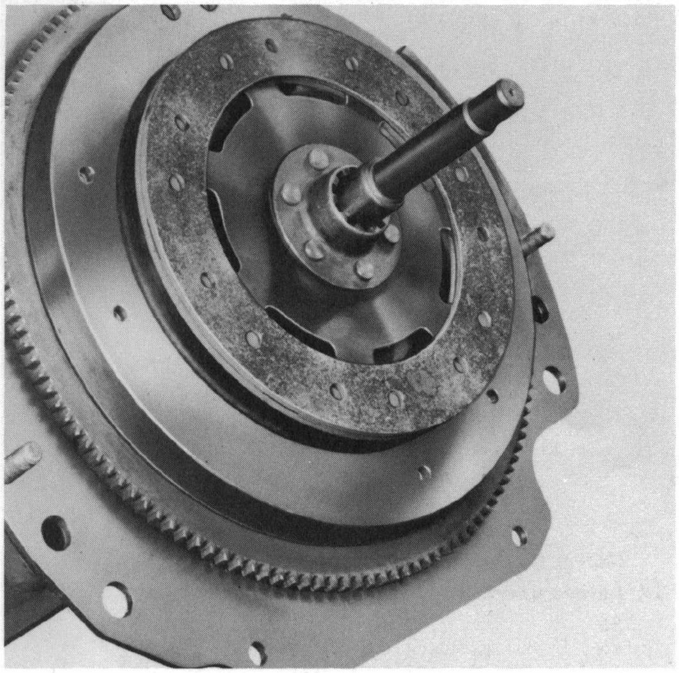


Fig. 24

PROCEDURE

1. Mount adaptor plate on engine.
2. Mount flywheel on crankshaft and torque the cap screws to 75 to 85 ft. lbs.

   NOTE: Flywheel mounting holes have been so spaced that flywheel can be assembled to crankshaft in only one respective position.
3. Using clutch disc alignment tool, engage disc to flywheel. (Figure 24)
4. Attach clutch pressure plate assembly to flywheel, torquing the cap screws to 15 to 18 ft. lbs.

Service Job No. 6.

PISTON, RINGS AND ROD ASSEMBLY

Pistons are of the aluminum alloy autothermic cam ground design and are of the slipper type with piston pin bosses reinforced by steel struts. Pistons must always be installed so that the dimple in the crown of the piston is nearest the front of the engine. Due to the rotation, the right side of the piston takes the major thrust force, thereby distributing the force of the power stroke uniformly to the connecting rod bearings. When the piston assembly is at room temperature (70°F.) the pin should be a light press fit into the pin bore. After the piston assembly reaches operating temperature, the pin will float in the piston pin bores.

Two compression and one oil control ring are used to control combustion chamber pressures.

The top compression ring is chrome-plated and has a tapered face which requires the largest diameter of the ring to be installed toward the bottom of piston.

Number two compression ring also has a tapered face and must be installed in the same manner as the top compression ring. The oil control ring is of the wedge channel type and is made of a close grained cast-iron alloy.

Connecting rods are special heat-treated alloy steel of the "I" type. The crankshaft with connecting rod bearing caps is retained by two alloy steel bolts. Pin bore is fitted with a replaceable bronze bushing which, when replaced, must be reamed and honed to size.

DISASSEMBLY PROCEDURE

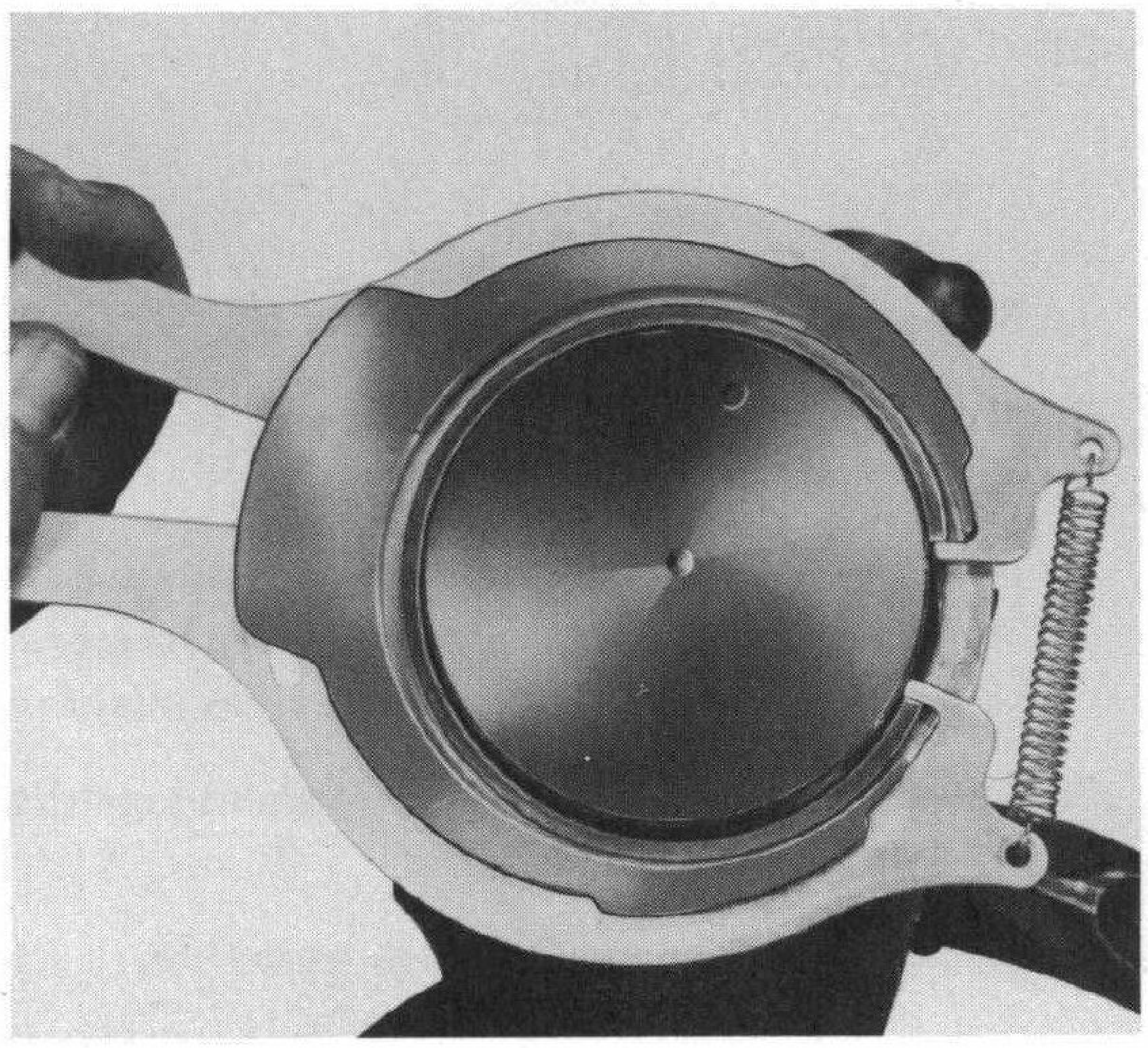


Fig. 25

1. Remove piston rings from piston using ring expander. (Figure 25)

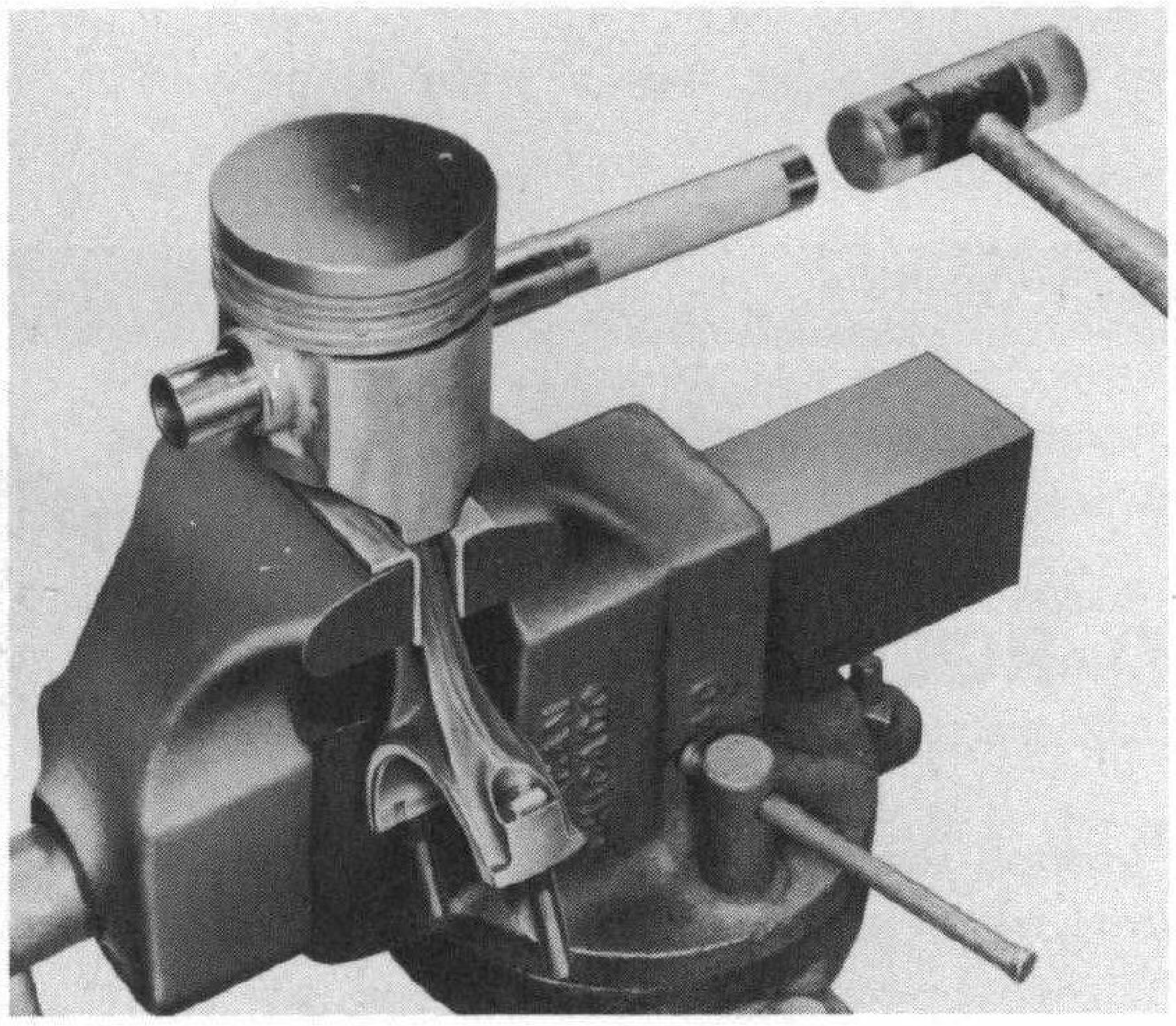


Fig. 26

2. Remove piston pin retainer and drive pin from piston and connecting rod. (Figure 26)

INSPECTION PROCEDURE

1. The importance of cleaning all parts in suitable carbon and varnish-removing solvent cannot be overemphasized. Parts cannot be properly inspected unless thoroughly clean.
2. Clean and inspect piston for galled condition on thrust faces and check new rings for side clearance which is as follows:

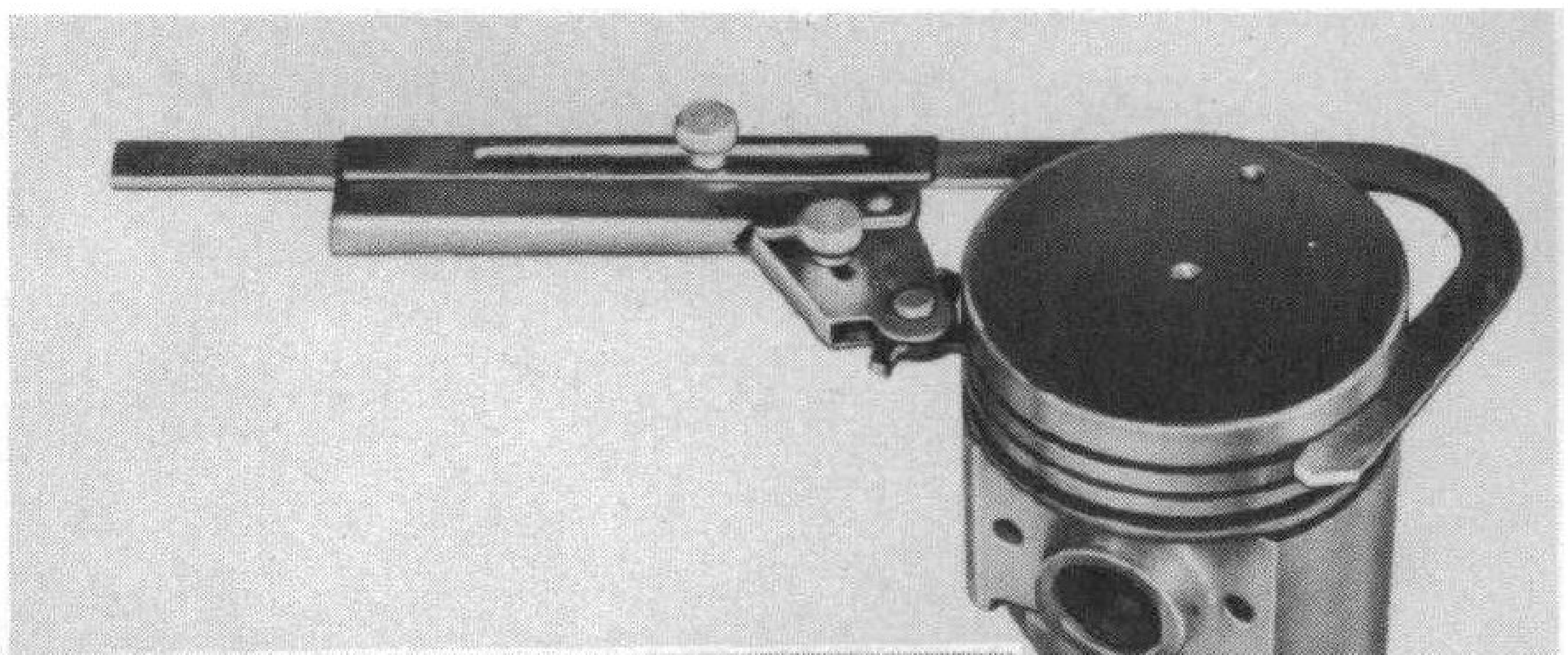


Fig. 27

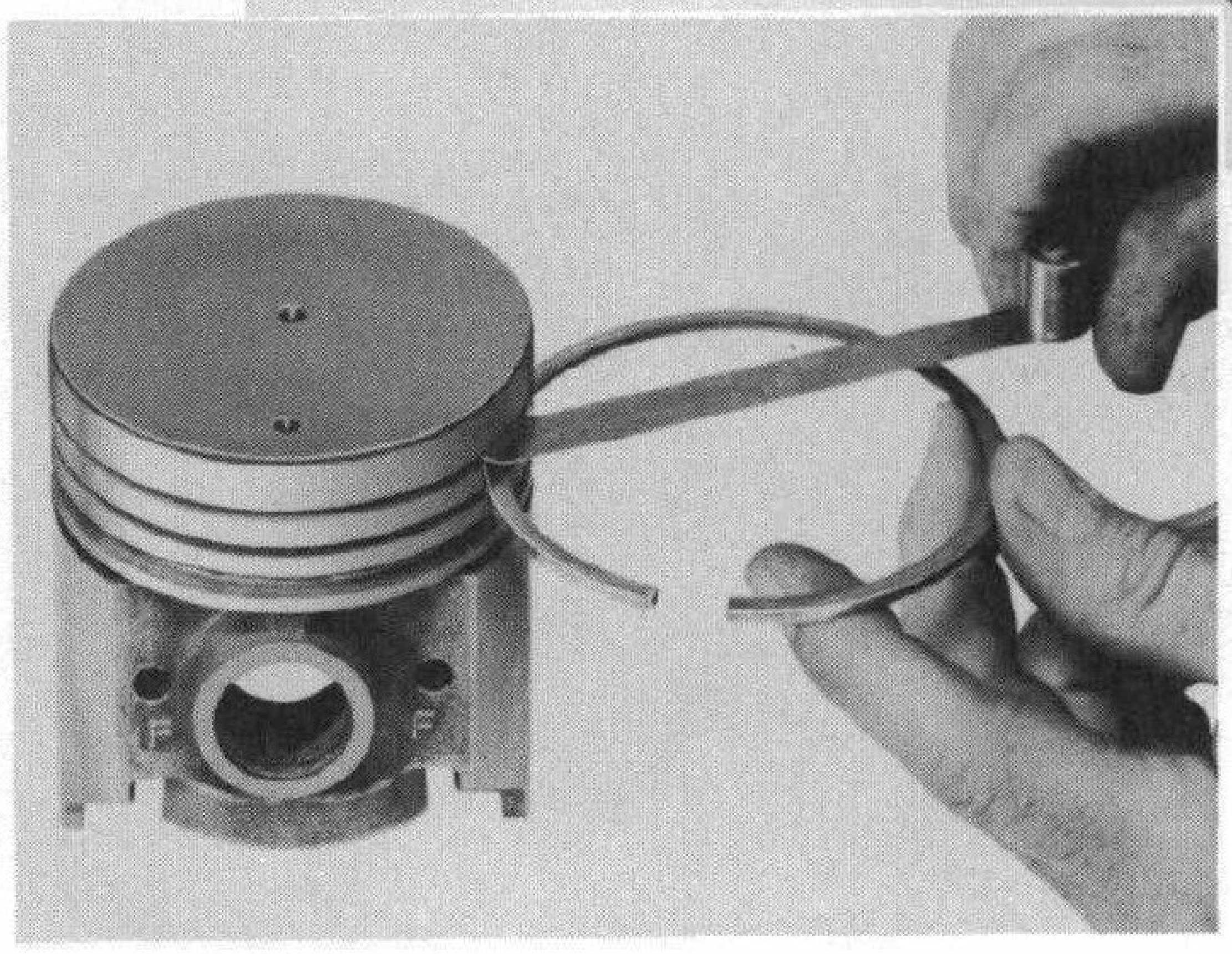


Fig. 28

NOTE: Clean piston ring grooves (Figure 27) before checking ring side clearance. (Figure 28)

a. Top compression ring .0015 inch to .0030 inch.

b. Second compression ring .0010 to .0025 inch.

c. Oil control ring .0015 inch to .0030 inch.

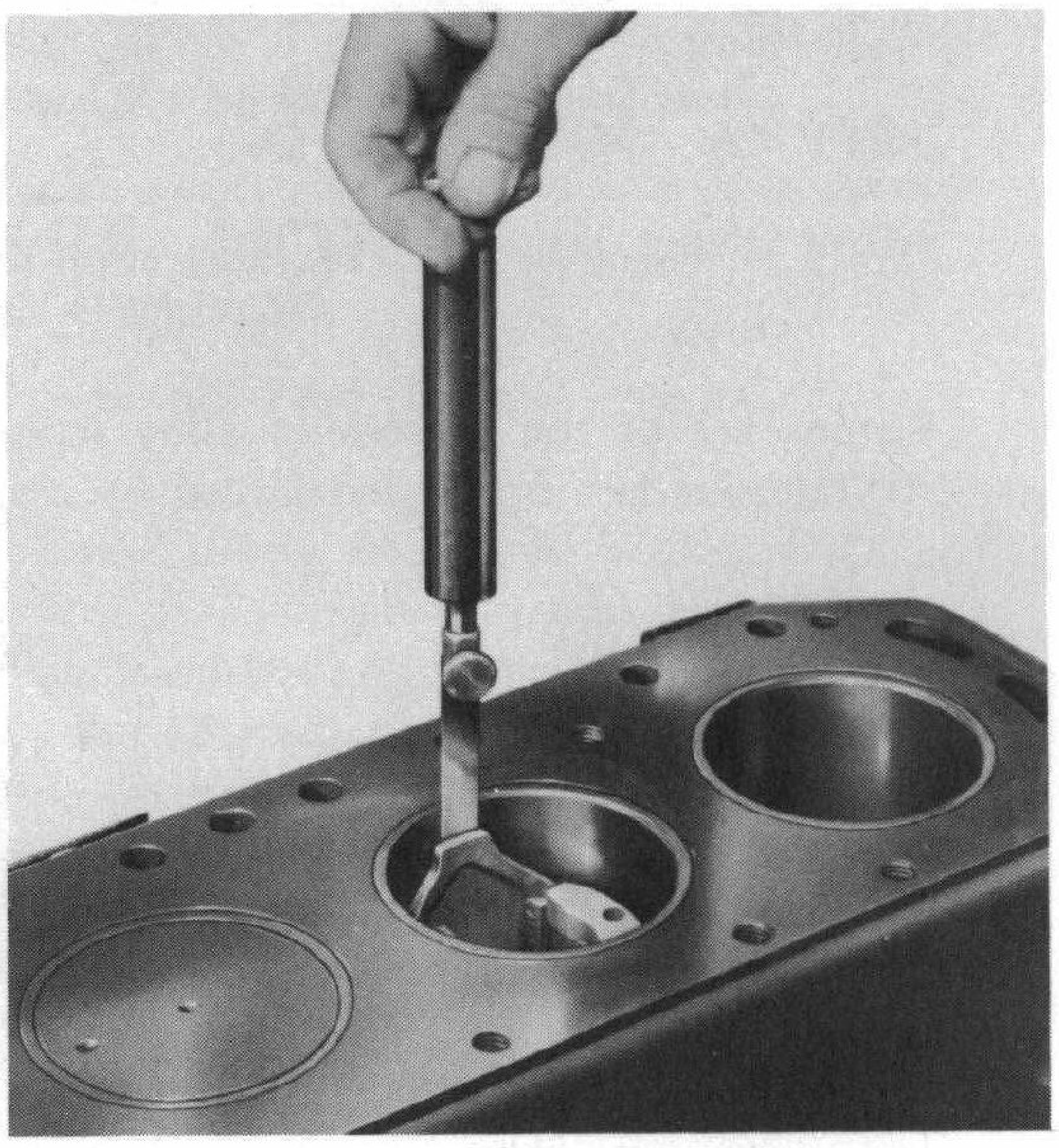


Fig. 29

3. Fit each piston to its respective sleeve bore using a pull scale with a .0015 x ½-inch feeler gauge. (Figure 29) In the majority of cases, to obtain the required fit of 5 to 10 pounds pull, it will be necessary to hone the sleeve bore. If honing is necessary, a suggested procedure is provided:

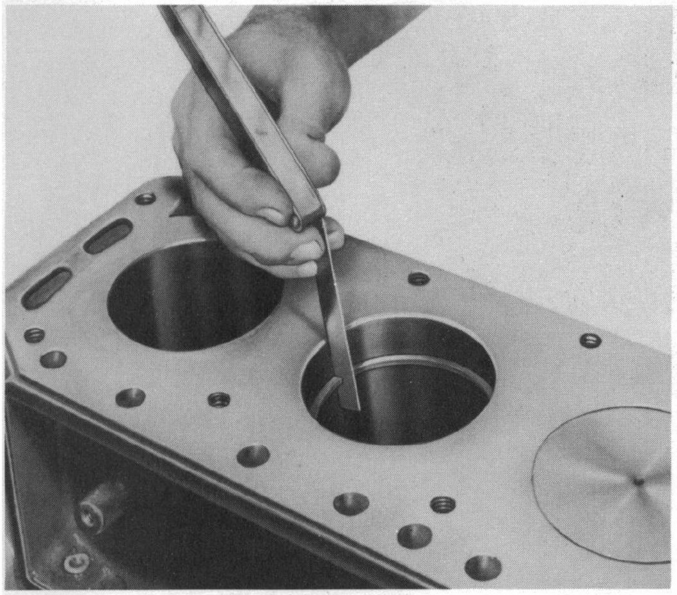


Fig. 30

a. Use a rigid type hone and No. 220 grit stones. A drill with a speed of 250 to 450 r.p.m. should be used to drive the hone. The stones must be used dry to obtain the desired cylinder sleeve finish.

NOTE: The speed of the hone and rapidity of the stroke govern the crosshatch marks on the sleeve. The crosshatch marks should intersect at approximately 90° for proper ring seating.

b. Operate the hone through the bore 10 or 12 complete strokes. Remove the hone, clean the sleeve with dry rags, and recheck the piston fit.

c. Repeat the above procedure until the necessary amount of material has been removed for the specified piston-to-bore fit.

CAUTION: Do not use gasoline or kerosene to clean the sleeve walls after the honing operation. Solvents of this type will not remove the abrasive but will further embed small abrasive particles into the pores of the cylinder block.

4. Clean the cylinder block of all foreign material as follows:

a. Wipe or remove as much of the abrasive material as possible.

b. Swab each sleeve wall with *clean* SAE 10 Motor Oil at least twice.

c. Wipe the oil out of the sleeves with clean rags.

d. Wash the sleeve bores with hot soapy water.

e. Flush water jackets to remove foreign material which might cause excessive wear to the water pump.

f. Remove the rags from the crankshaft and wash the crankshaft off with hot soapy water.

g. Dry the cylinder block thoroughly, using compressed air.

5. Fit each piston ring to the bore in which it is to operate. (Figure 30) The following are the specified ring end gaps.

a. Top compression ring .010 inch to .020 inch.

b. Second compression ring .010 inch to .020 inch.

c. Oil control ring .010 inch to .020 inch.

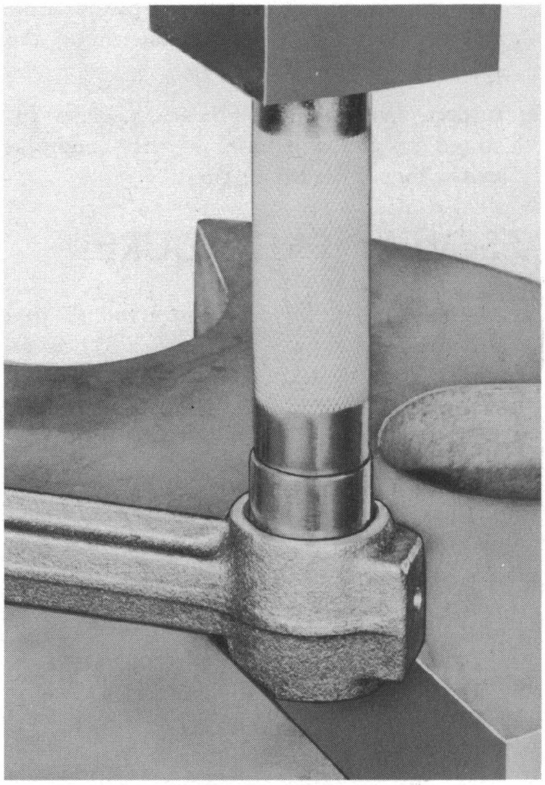


Fig. 31

6. Check connecting rod pin bushings for fit by pushing the piston pin through the bushing. A light thumb press fit should be obtained. If the pin drops through of its own weight, the rod bushing must be removed (Figure 31) and the new bushing reamed and honed to size until proper fit is attained.

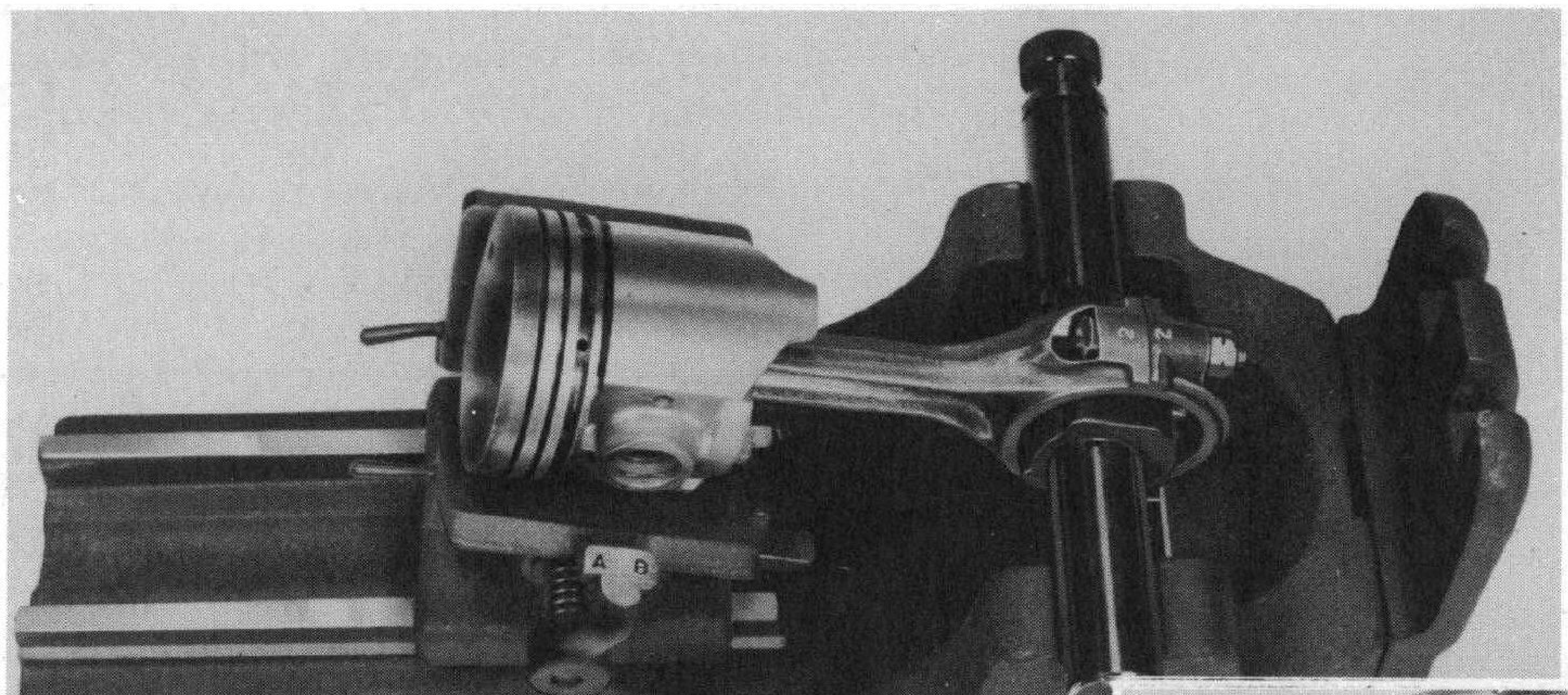


Fig. 32

7. Check the connecting rods for proper alignment. (Figure 32) The maximum allowable twist is .0015 inch twist per inch. The maximum allowable bend is .0005 inch. To install connecting rods which are not in perfect alignment will accelerate piston wear and prohibit piston rings from doing the job they are intended to do.

8. Inspect connecting rod bearing liners for scored or galled babbitt. If this condition exists, they must be replaced.

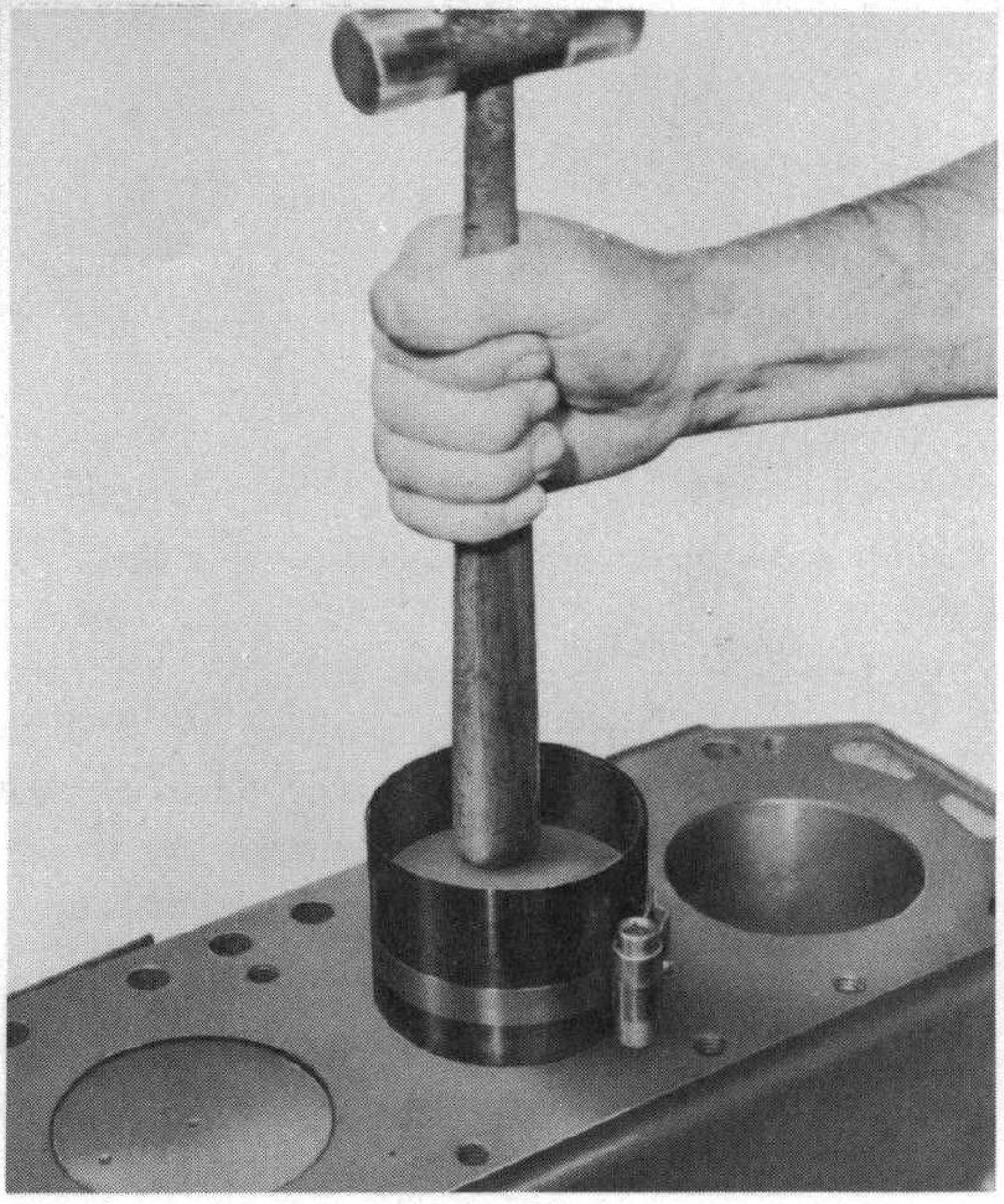


Fig. 33

ASSEMBLY PROCEDURE

1. Assemble piston to connecting rod so that dimple in piston crown (Figure 33) is toward front of engine and numbers stamped on connecting rod are toward the camshaft side of engine.

2. Install piston rings on piston using ring expander. (Figure 25) A good ring expander must always be used, so as to prevent ring distortion and possible breakage. Be sure rings are installed with their proper sides toward the piston crown.

3. Stagger ring end gaps, compress rings and install piston and rod assemblies into their respective bores. (Figure 33)

4. Using Plastigage, determine the connecting rod liner to crankshaft journal clearance. (See Figure 13) The specified clearance is .0005 inch to .0021 inch. Torque the cap nuts to 45 to 50 ft. lbs. If clearance exceeds the maximum, an undersize liner must be installed to obtain the specified clearance. Should insufficient clearance exist, the crankshaft journal must be ground undersize.

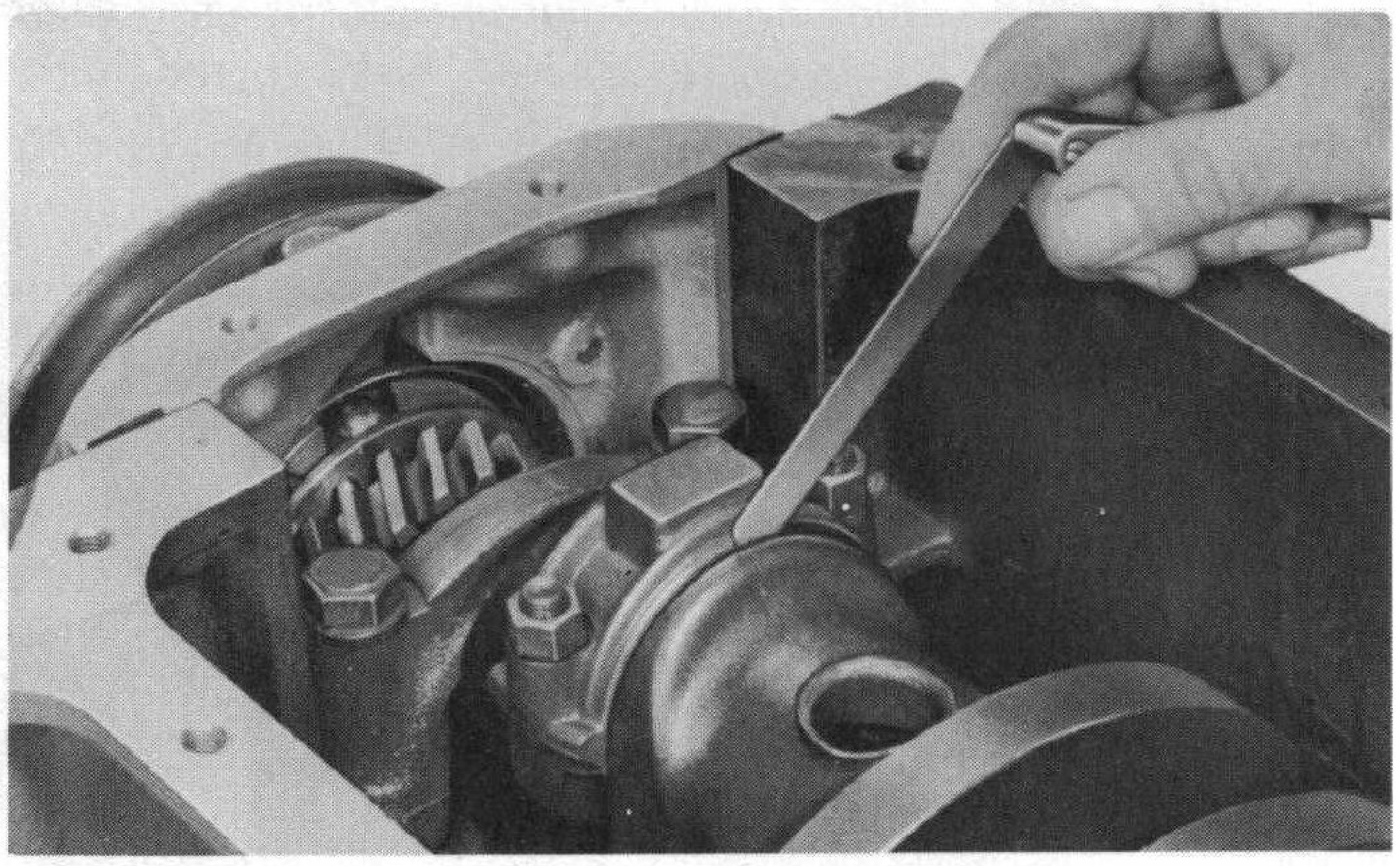


Fig. 34

5. Side clearance of connecting rods to crankshaft should be .003 inch to .007 inch. If the maximum clearance is exceeded the rod must be replaced. (Figure 34)

6. After installing rod cap nuts and properly torquing them, install lock nuts finger-tight plus one-quarter turn.

OIL PUMP, PAN AND OIL FILTER

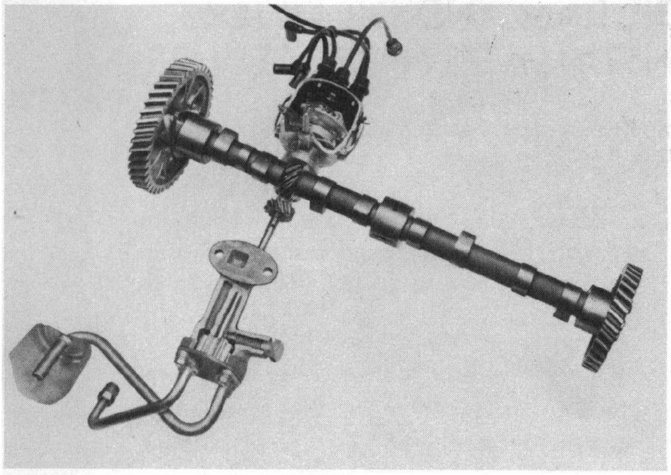


Fig. 35

The gear type oil pump incorporates a pressure relief valve. And has a capacity of 3.4 G.P.M. at 1,400 engine r.p.m. It is driven by the distributor drive shaft which is driven by the helical gear which is integral with the camshaft. (Figure 35)

The oil pan is pressed steel and does not act as a structural member. It may be removed without separating the axle from the engine.

All oil passing through the oil pump is filtered by a "Full-Flow" type filter. Integral with the filter bolt is a pressure relief valve which operates only if the filter element becomes plugged due to improper servicing.

OIL PUMP DISASSEMBLY PROCEDURE

1. Disassemble pump and thoroughly clean. (Figure 36)

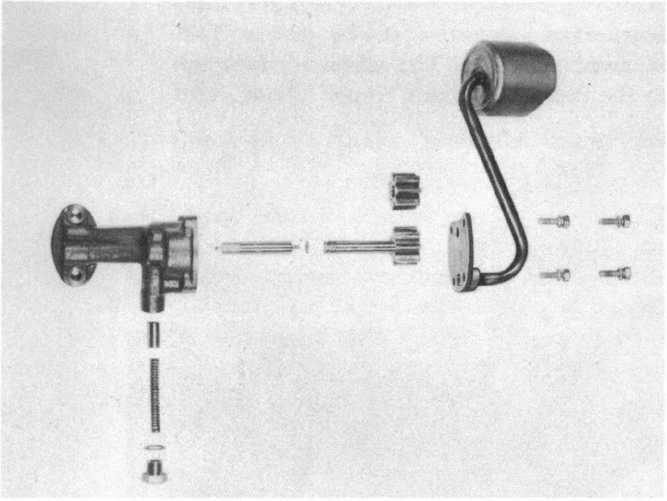


Fig. 36

INSPECTION PROCEDURE:

1. Check the following for proper clearance:
   a. Gear to side of pump body. (Figure 37) Gear to side of pump body should not exceed .005 inch clearance.
   b. Drive shaft to body clearance. Drive shaft to body clearance should be .0005 inch to .0015 inch.
   c. Check for wear on pump cover by using a straight edge and feeler gauge. (Figure 38)

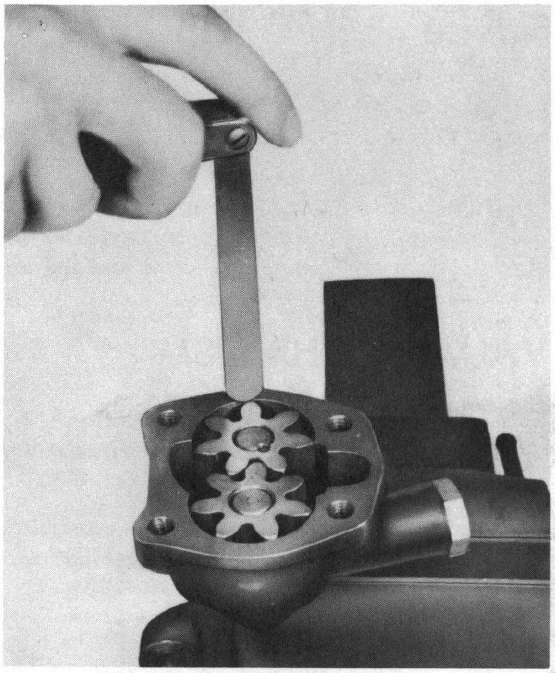


Fig. 37

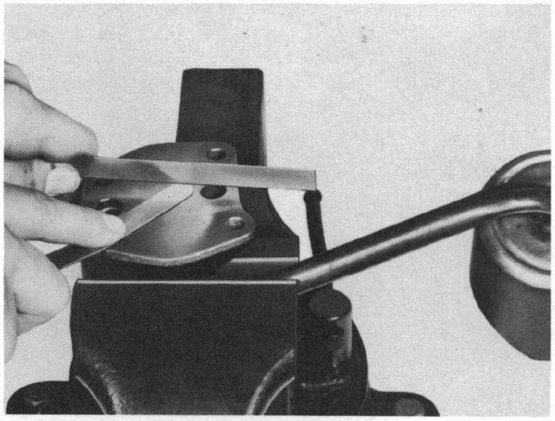


Fig. 38

2. Check relief valve spring tension on spring tester. At 1.38 inch height, tension must be 2 lbs.

OIL PUMP ASSEMBLY AND INSTALLATION PROCEDURE

1. Install pressure relief valve plunger assembly and install a new gasket with the oil relief nut.
2. Attach oil pump body to cylinder block and tighten the two nuts.
3. Engage gears to pump body.
4. Install oil pump cover, torquing cap screws to 30 to 35 ft. lbs.
5. Install oil filter inlet tube assembly.

OIL PAN AND OIL FILTER INSTALLATION PROCEDURE

1. Place pan and gasket in position and torque oil pan cap screws to 15 to 18 ft. lbs.
2. Install oil filter assembly. Take care to obtain a good seal between cylinder block and filter case. Torque mounting bolt to 20 to 25 ft. lbs.

NOTE: In normal tractor overhaul procedure, if the starter has been removed, it must be replaced before oil filter is replaced.

Service Job No. 8.

CYLINDER HEAD ASSEMBLY RECONDITIONING AND INSTALLATION

The cylinder head is made of high-grade cast iron and incorporates exhaust valve seat inserts. The overhead valve mechanism and cylinder head may be removed as a unit. The exhaust valves are known as the "Free-Valve" type and the intake valves are the Ford "Free-Turn" type.

VALVE MECHANISM DISASSEMBLY

1. Remove valve rocker arm support assembly from the cylinder head.
2. Remove exhaust and intake valve assemblies from cylinder head using valve spring compression tool. (Figure 39)

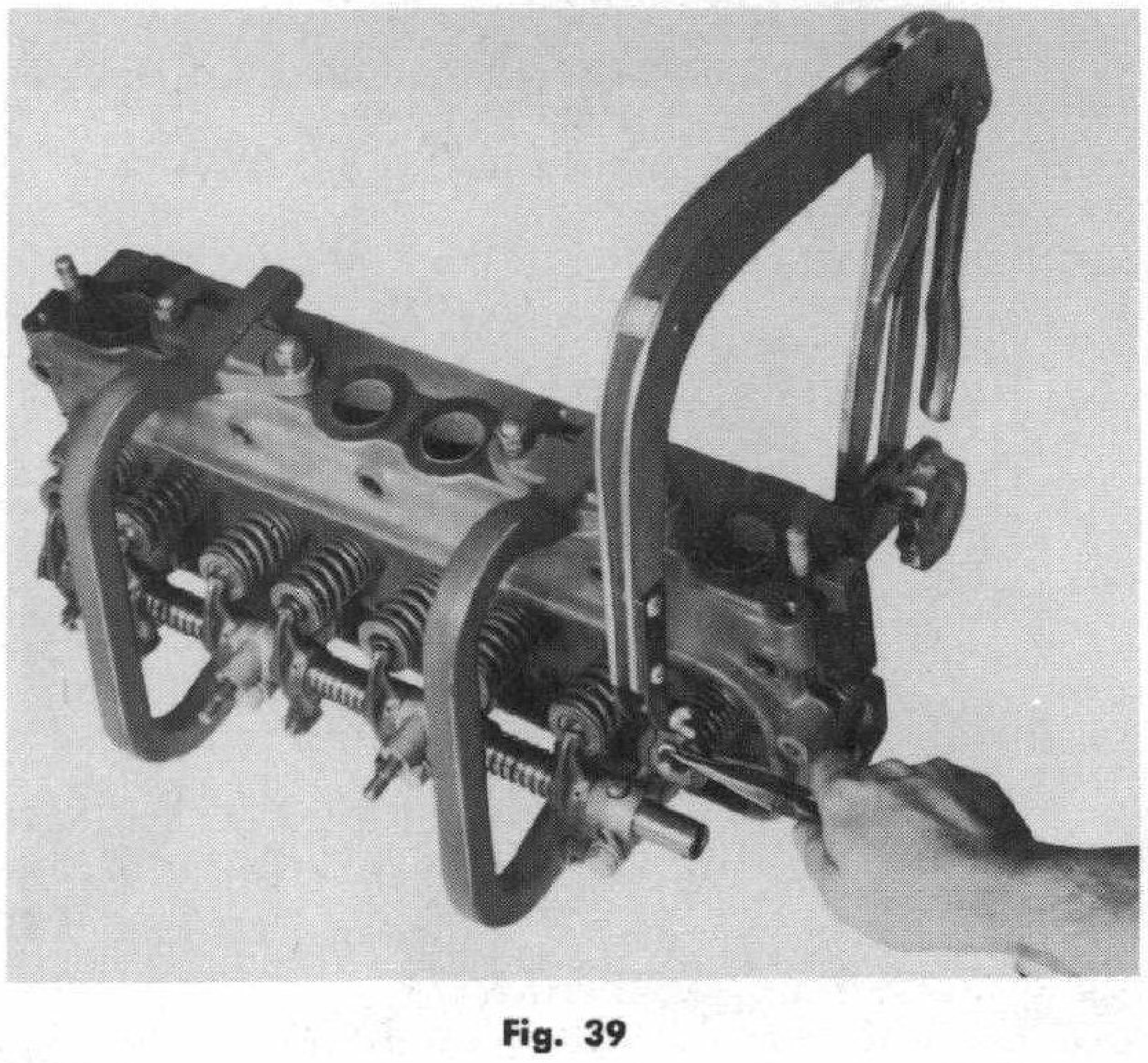


Fig. 39

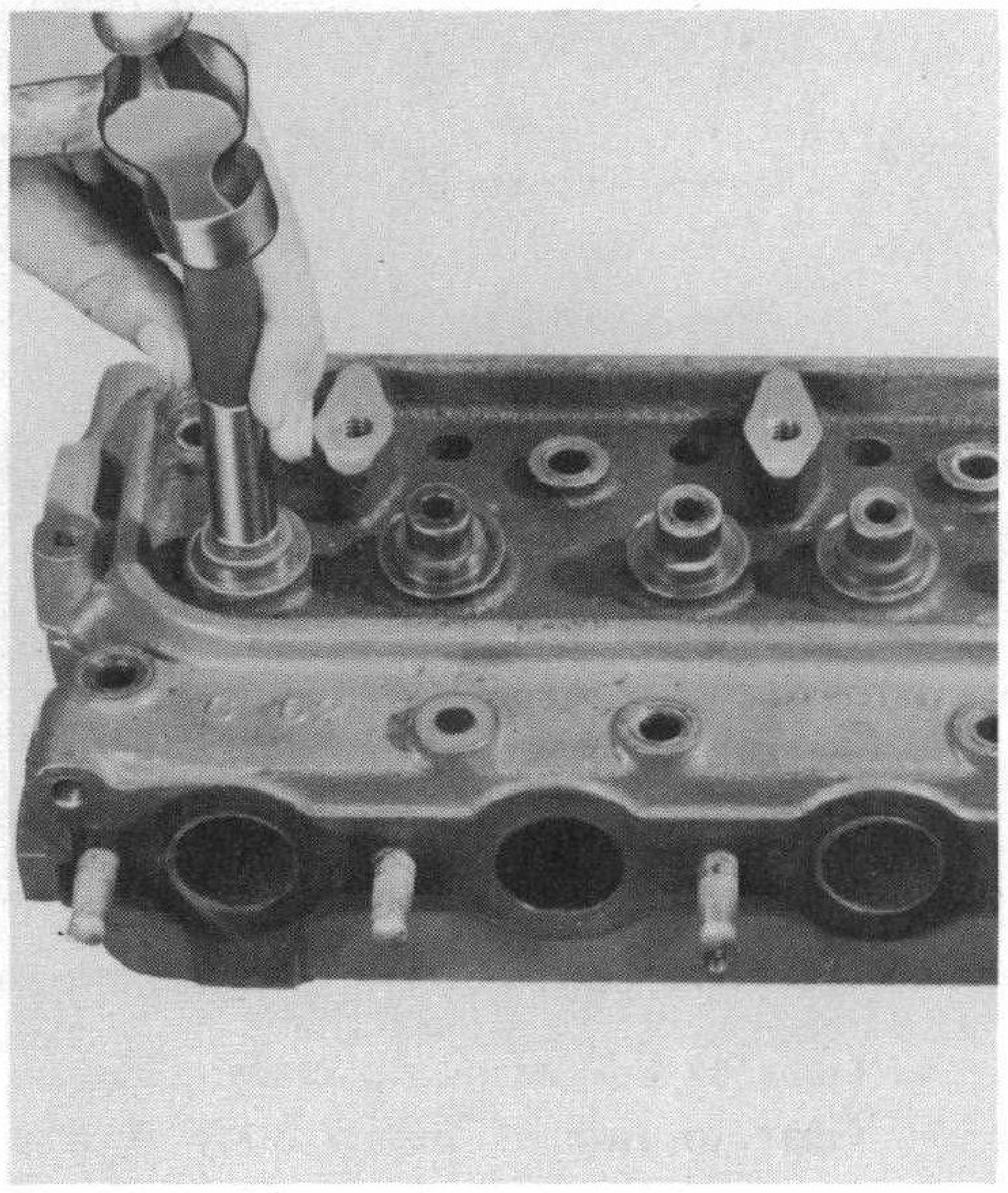


Fig. 40

3. Using valve guide removing tool, remove intake and exhaust valve guides from cylinder head as required. (Figure 40)
4. Disassemble valve rocker arms and valve rocker support shaft from rocker arm shaft supports.

INSPECTION PROCEDURE

1. Clean all foreign material from valve guides, valve stems, and combustion chambers.

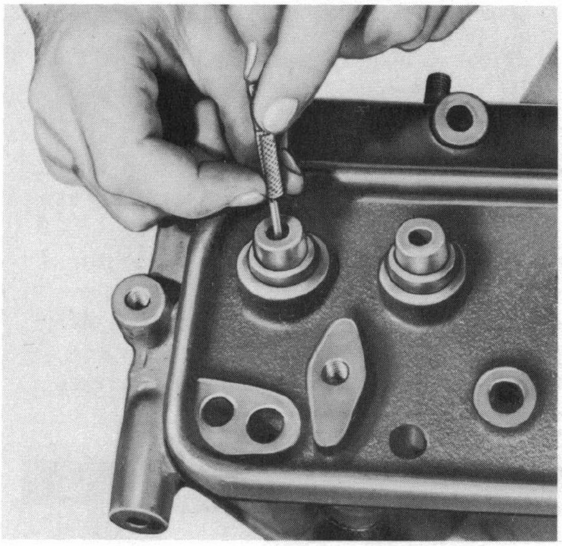


Fig. 41

2. Check clearance between valve stem and guide with a small hole gauge and micrometer. (Figure 41) This clearance should be .002 to .003 inch. The intake valve stem diameter should be .342 inch and the exhaust valve should be .341 inch diameter.
3. Check the cylinder head for cracks and warpage.
4. Check the rocker arm bearing diameter. It should be .783 inch to .784 inch, and the rocker arm support shaft diameter must be .780 inch to .781 inch. If clearance exceeds .007 inch, either the rocker arm, or shaft, or both will need to be replaced.
5. Recondition valve faces and seats. The width of the exhaust valve seat is .065 inch to .105 inch and the width of the intake valve seat is .070 inch to .080 inch. If the width exceeds maximum, it may be reduced by using a 30° stone or a 60° stone to chamfer the original 45° seat. Total indicated seat runout should not exceed .002 inch.

Refinish valve faces with a 45° angle taking care to leave 1/16-inch face margin. If less than 1/16-inch is retained after refinishing, the valve must be replaced.

ASSEMBLY PROCEDURE

1. Using valve guide replacing tool, install valve guides in cylinder head. (Figure 42)

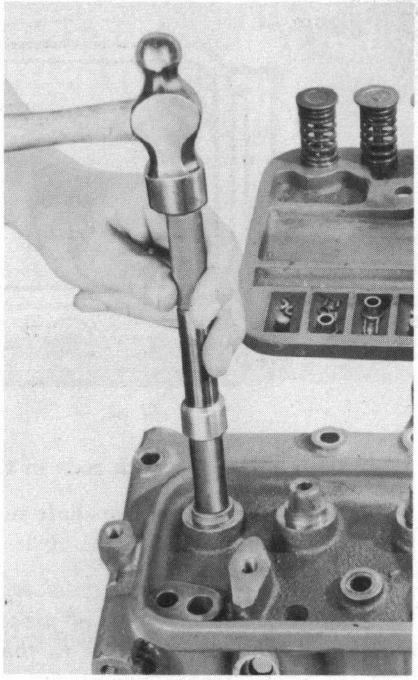


Fig. 42

2. Replace all valve assemblies in cylinder head using valve spring compressor tool (Figure 39) taking care that they are assembled to their original guides.

   NOTE: Install three (3) center cylinder head hold-down bolts previous to attaching rocker arm support assembly to cylinder head.

3. Assemble rocker arm and rocker arm support assemblies (Figure 43) and attach to the cylinder head.
4. Back out rocker arm adjusting screws to prevent damage to the valve push rods.

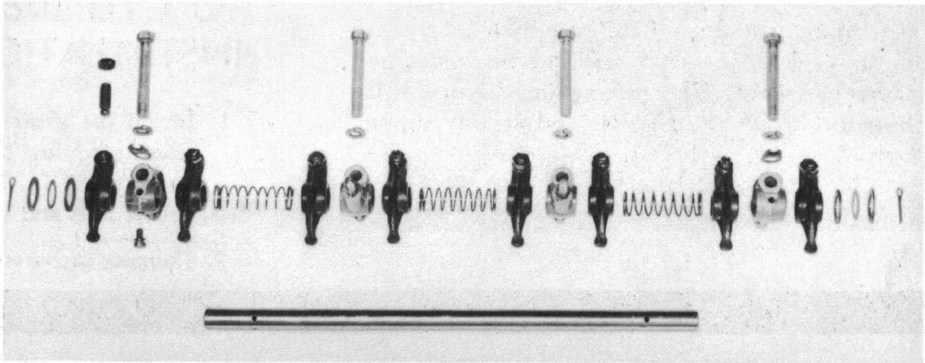


Fig. 43

CYLINDER HEAD TO BLOCK ASSEMBLY INSTALLATION PROCEDURE

1. Install cylinder head assembly to the block. Take care to prevent damage to the gasket. Torque cylinder head hold-down bolts to 65 to 70 ft. lbs. (Use sequence illustrated in Figure 44.)

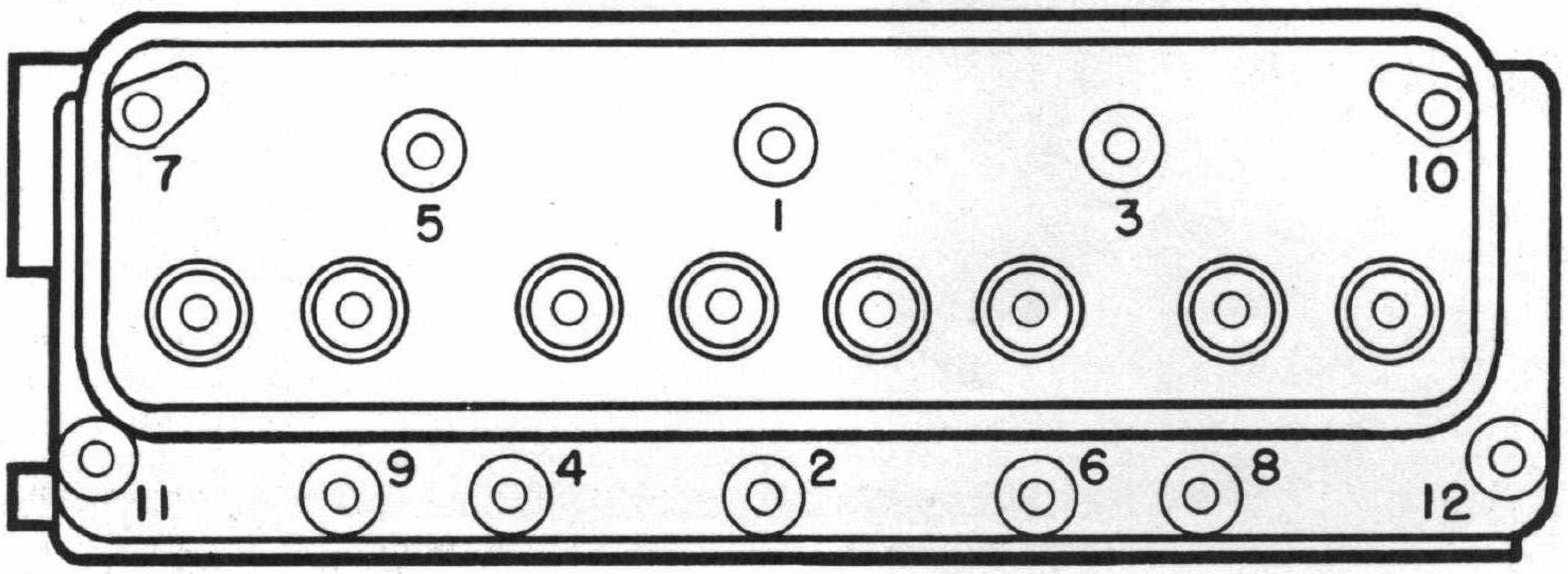


Fig. 44

2. Install eight (8) push rods in the block.
3. Torque the rocker arm shaft support to the cylinder head with 45 to 50 ft. lbs.

   NOTE: Before torquing the rear and front support, install the rear oil pressure line and the front oil return line to the bracket on top of the rocker arm shaft support.

4. Adjust valve clearance on intake and exhaust to .015 inch.
5. Install valve rocker arm cover, torquing the acorn nuts to 8 to 10 ft. lbs.
6. Install spark plugs.

Service Job No. 9.

MANIFOLD AND CARBURETOR ASSEMBLY INSTALLATION

The intake and exhaust manifolds are integral and made of cast iron with a machined surface for both the carburetor and the surfaces which come in contact with the gasket-to-cylinder head connections.

The manifold assembly should be cleaned with a suitable carbon-removing type of solvent. The old gaskets should be completely removed from the manifold previous to inspection.

INSPECTION

A thorough job of manifold inspection for cracks or warpage of the machined surface cannot be overemphasized. Any cracking or warpage will be cause for a loss of power and erratic engine operation.

MANIFOLD ASSEMBLY TO CYLINDER HEAD INSTALLATION PROCEDURE

1. Install the gaskets and manifold to cylinder head, torquing the six (6) hold-down nuts to 40 to 50 ft. lbs. Start with the two (2) center nuts and work toward the outside.
2. Connect carburetor and governor linkages.

Service Job No. 10.

WATER PUMP, FAN ASSEMBLY AND THERMOSTAT INSTALLATION

The water pump is of the centrifugal type with the capacity of 16 G.P.M. at 1,400 engine r.p.m. It has a ratio to engine speed of 1.5:1.

The thermostat starts to open at 160°F. and it is fully open at 180°F. The engine can deliver its maximum power and economy only if the coolant temperature is between 160°F. and 180°F.

INSPECTION PROCEDURE

1. Inspect thermostat for wear and proper opening and closing by using hot water and a thermometer. If excessive clearance exists in the water pump bearings or seals, it will be necessary to replace these parts.

THERMOSTAT AND WATER PUMP INSTALLATION

1. Install thermostat in cylinder head with thermo unit toward rear of engine.
2. Install water outlet connection.
3. Install water pump and fan assembly to cylinder block, torquing cap screws to 15 to 18 ft. lbs.

Service Job No. 11.

IGNITION SYSTEM

The ignition system is six-volt battery operated.

The ignition system consists of a distributor assembly, a coil, four (4) spark plugs and the necessary wires and terminals for connecting these units.

The firing order is 1-2-4-3. Automatic advance of ignition timing is controlled by centrifugal flyweights, the basic setting being 8° B.T.C. at 450 r.p.m. and with a maximum advance of 29° to 31° at 2200 r.p.m.

Breaker point gap is specified at .024 inch to .026 inch. This is very important, as the percentage of dwell is based on this gap.

Spark plugs should be cleaned, inspected, adjusted to .025 inch to .028 inch.

DISTRIBUTOR DISASSEMBLY PROCEDURES

Before disassembling the distributor for overhaul, it is advisable to test the ignition advance and dwell. These tests will give valuable information on the distributor conditions and indicate the parts which need replacement.

A. Breaker Plate Removal.

1. Remove terminal housing, rotor and dust seal from the distributor, and the rubber "O" ring oil seal from outside of lower part of distributor housing. Place the housing in the distributor holding block and clamp in a vise. (Figure 45) Disconnect the primary strap and the condenser lead from the distributor point assembly primary terminal. Remove the two (2) screws holding the distributor point assembly to the breaker plate.
2. Remove the screws attaching the breaker plate to the distributor body.
3. Disconnect the primary strap from the distributor housing.

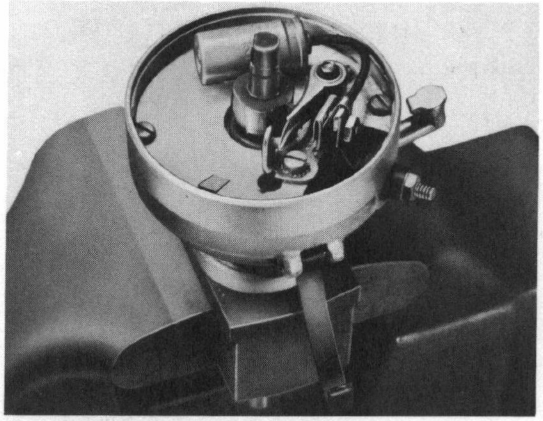


Fig. 45

B. Shaft And Cam Removal.

1. File off the rivet head on the drive gear and remove rivet.

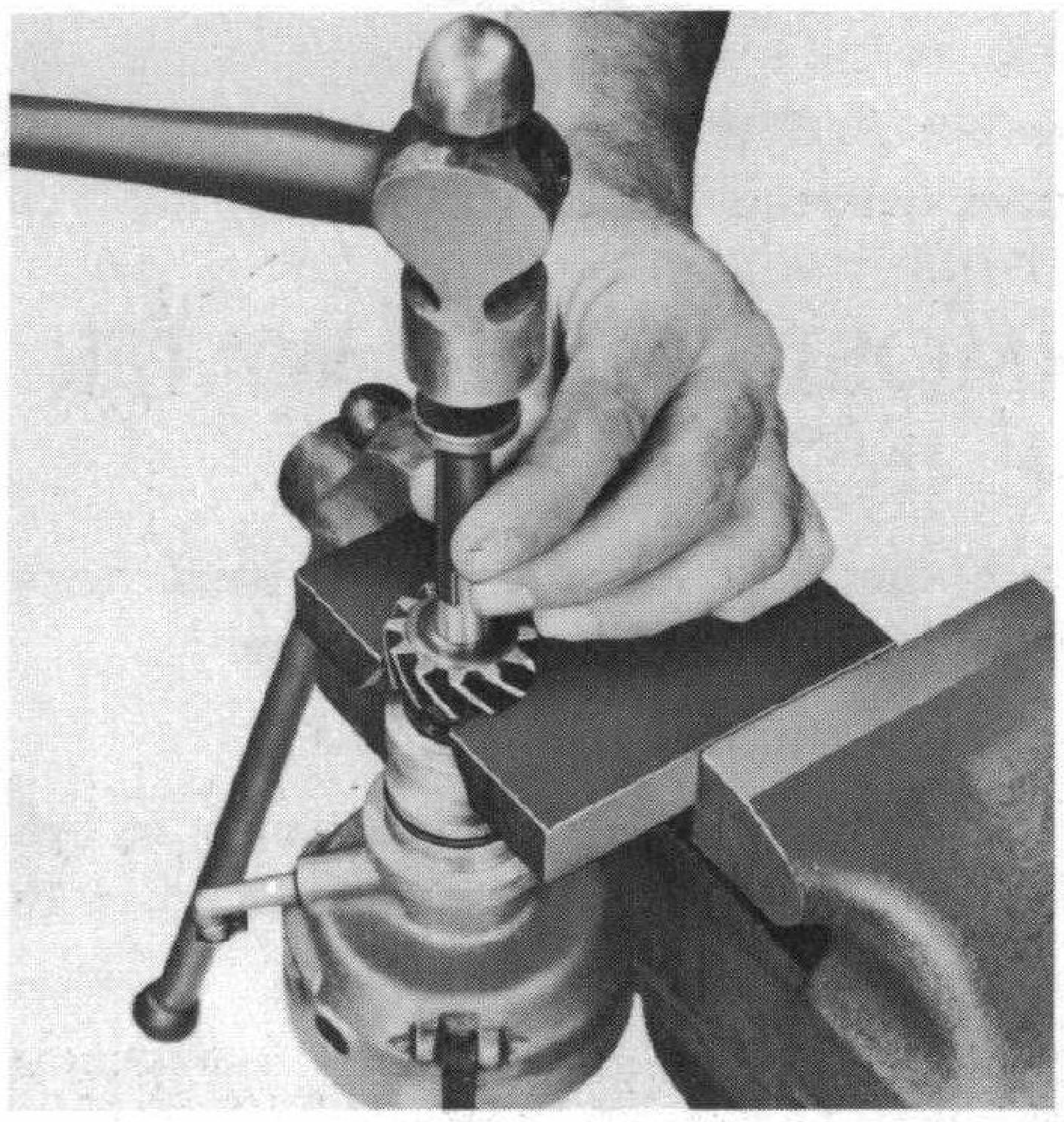


Fig. 46

2. Remove gear from shaft assembly using special tool. (Figure 46) Disengage shaft assembly from distributor housing.
3. Remove retainer from distributor shaft and remove flyweight assembly.
4. Remove rubber oil seal from bottom end of distributor housing.

INSPECTION PROCEDURE

1. Inspect the distributor shaft and bushing for wear.

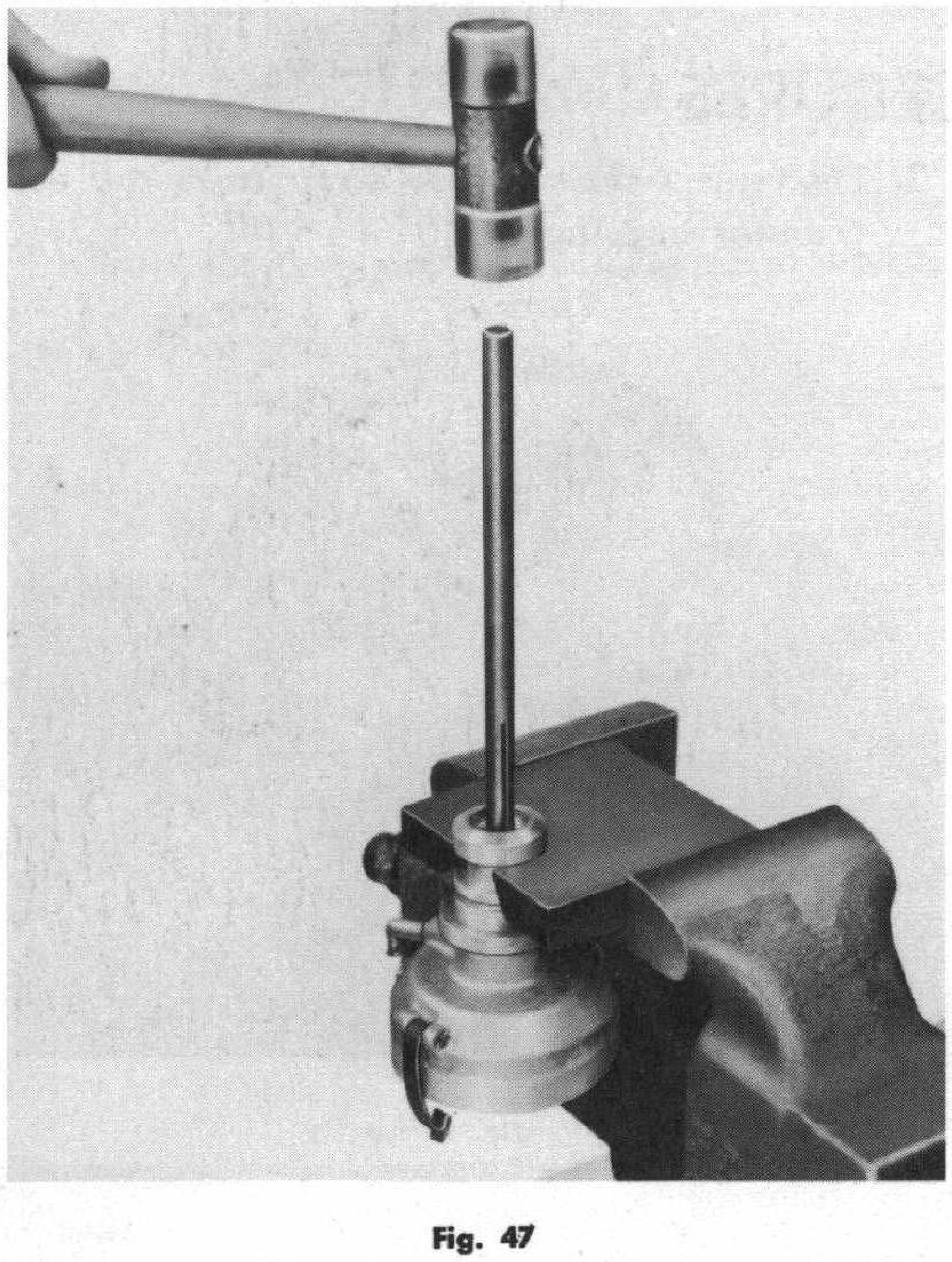


Fig. 47

2. Remove the distributor shaft bushing with special tool. (Figure 47)

   NOTE: The shaft bushing must always be removed by driving from the bottom of the distributor, otherwise it is impossible to remove.

3. Inspect flyweight assembly for freedom of movement.
4. Inspect surfaces of cam for smoothness. If any roughness is found, the cam must be replaced.

ASSEMBLY PROCEDURE

A. Bushing And "O" Ring Installation.

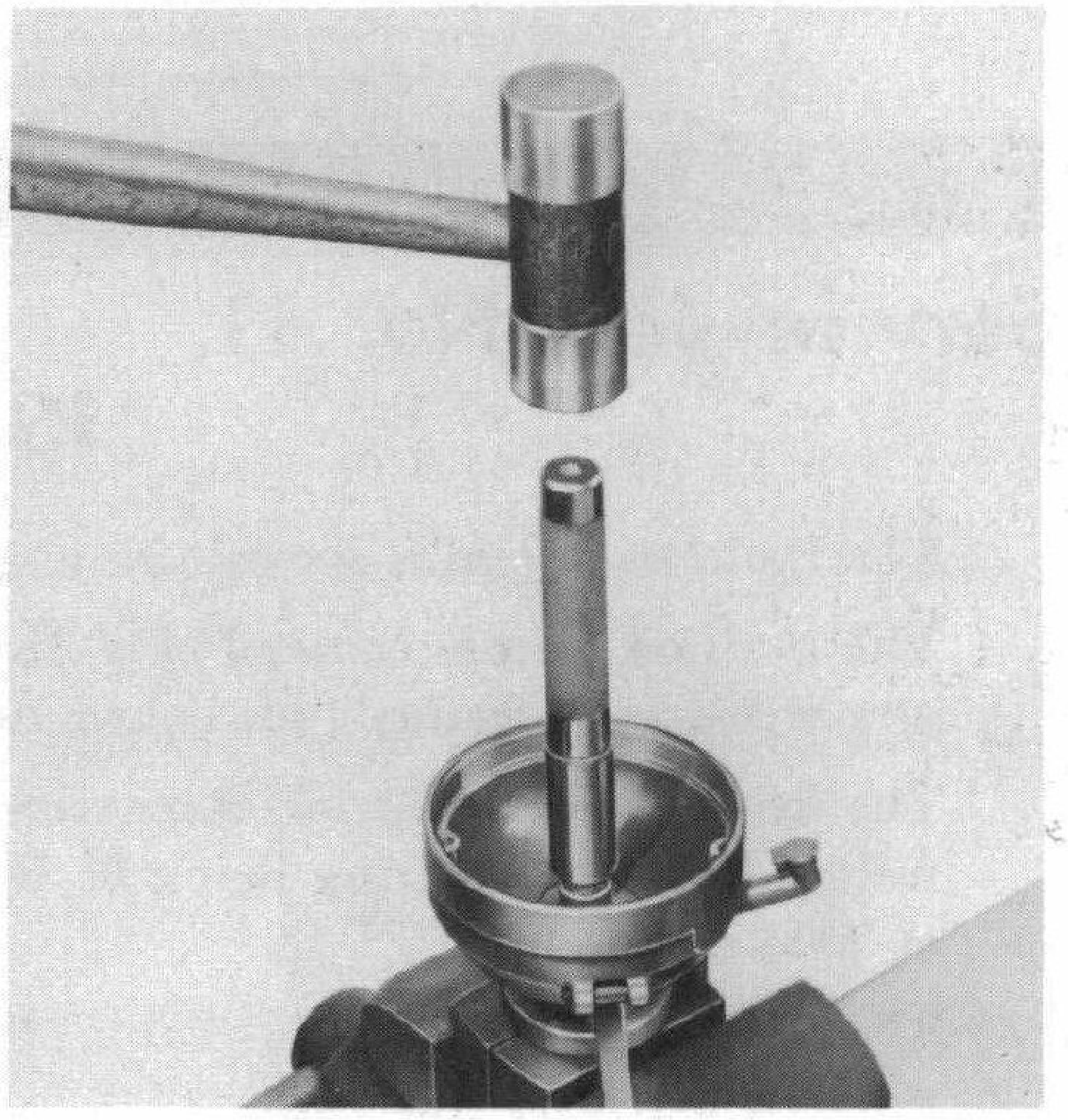


Fig. 48

1. Place bushing in distributor body and drive with special tool until flush with top of distributor spot face. (Figure 48)
2. Properly size the bushing using a burnishing tool. (Figure 49)
3. Replace "O" ring seal.

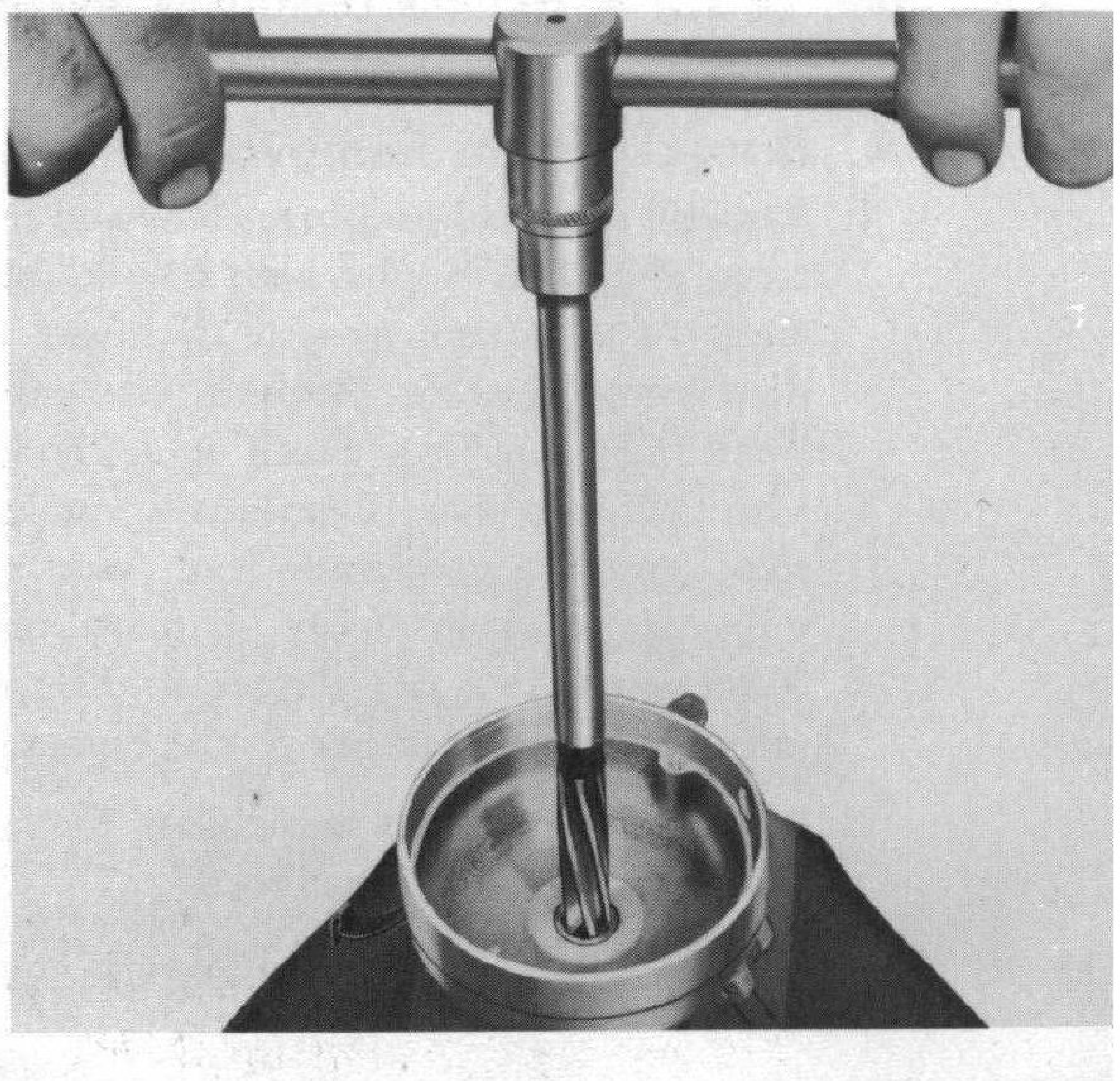


Fig. 49

B. Shaft And Breaker Plate Assembly Procedure.

1. Install shaft oil seal.
2. Assemble cam and weights assembly to distributor shaft and install in distributor body.

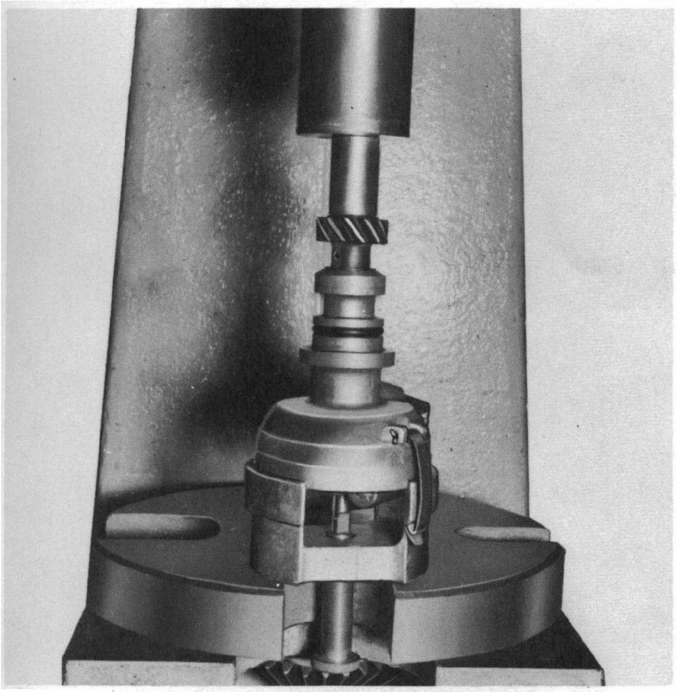


Fig. 50

3. Install distributor gear on shaft using special tools. (Figure 50)

NOTE: Before riveting gear to shaft, check end play of shaft with respect to distributor housing. The specified clearance is .021 inch to .046 inch. This is controlled by spacers between the gear and housing. (Figure 51)

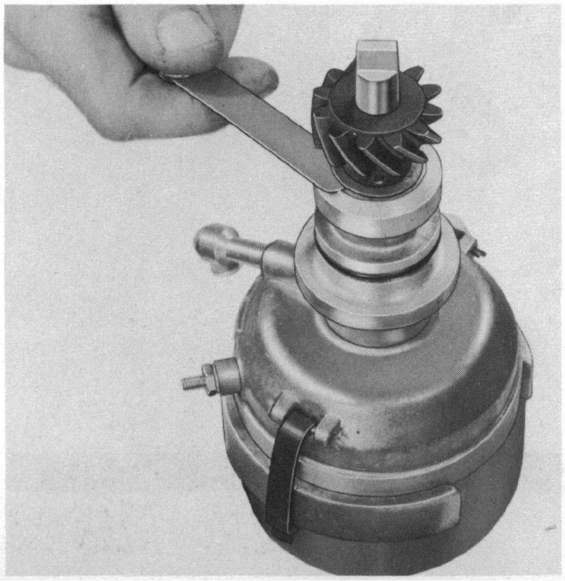


Fig. 51

4. Install the primary strap to the distributor housing.
5. Position the breaker plate in the housing.
6. Place the condenser lead, primary strap, lock washer, and nut on the distributor point primary terminal and securely tighten the nut.
7. Install the distributor point assembly. Be sure the pivot pin enters the hole in the breaker plate. Install the primary strap and the screws in the breaker assembly.
8. Adjust distributor point spacing so that the gap is .024 inch to .026 inch. (Figure 52)

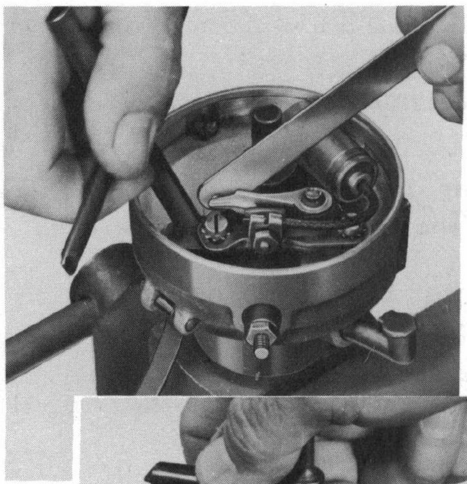


Fig. 52

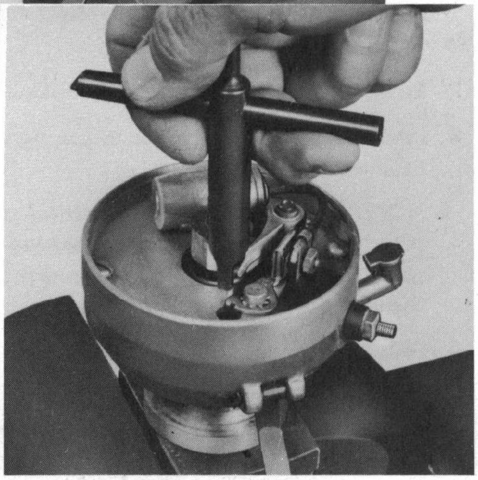


Fig. 52

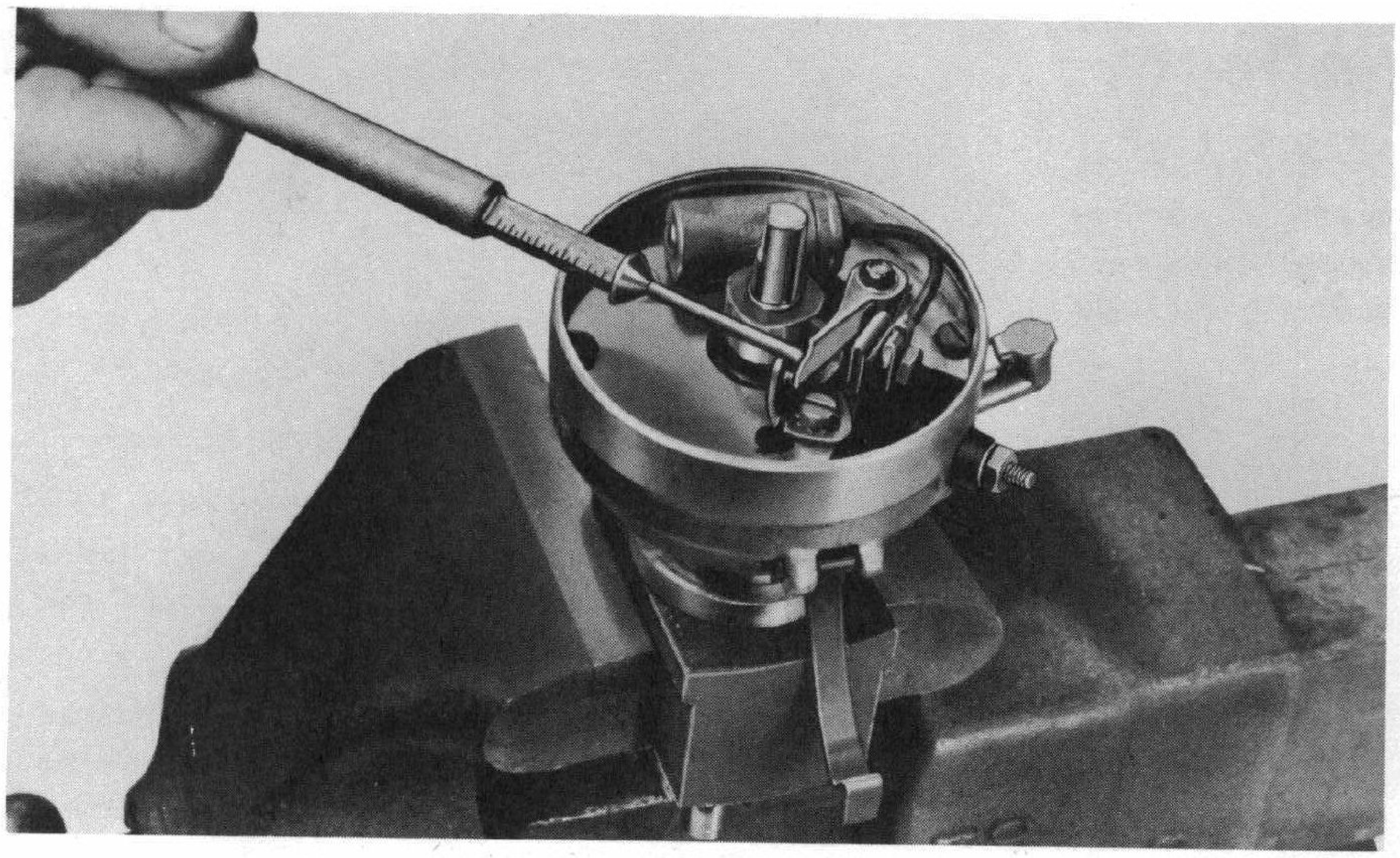


Fig. 53

9. Check breaker point spring tension using scale. (Figure 53) Spring tension should be 17 to 20 ounces for proper breaker point operation. To increase tension, slide steel leaf so as to decrease radius at breaker point pivot arm.

   a. Lubricate cam with cam grease part No. 8A-19575.

   WARNING: Do not overlubricate!

10. Replace dust seal, clip and rotor.

    NOTE: Align dust shield with tang on distributor plate housing. (Figure 54)

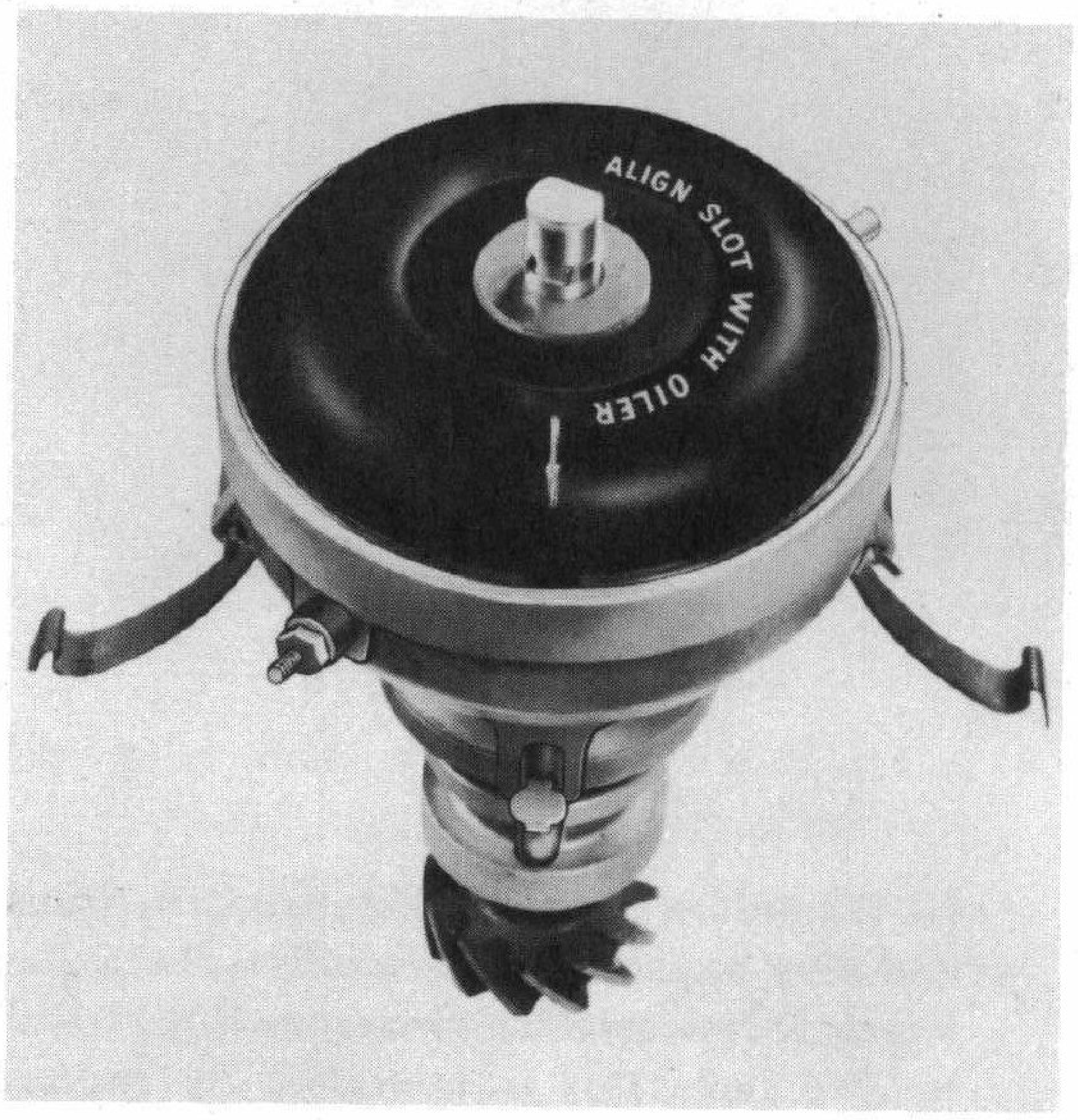


Fig. 54

C. Install Distributor To Engine As Follows:

1. Install Nos. 2, 3, and 4 spark plugs and rotate engine until T.D.C. is obtained on the compression stroke in No. 1 cylinder.
2. Position rotor to No. 1 firing position.
3. Insert distributor to engine engaging distributor and camshaft gears.

   NOTE: Make sure rotor is in firing position after installation. Rotate the engine to engage the distributor to oil pump drive if distributor does not seat properly.

4. Install terminal housing and spark plug wires.
5. Install coil to block and install primary and secondary wires.

D. Install Generator And Fan Belt.

Section II

TRANSMISSION

Section II

TRANSMISSION

Service Job No. **Page**

1. Transmission Removal and Installation 23
2. Disassembly and Assembly of the Transmission Cover and Gear Shift Assembly 24
3. Main Drive Gear and Shaft 25
4. Transmission Main Shaft 25
5. Transmission Countershaft 27
6. Reverse Idler Shaft 28
7. Servicing the PTO Shifter Assembly 29
8. The PTO Shaft Assembly 30

Service Job No. 1.

TRANSMISSION REMOVAL AND INSTALLATION

Because of the weight of the transmission housing and assembly, it is important to exercise care in properly supporting the tractor center housing and the transmission when removing or installing the transmission. Make sure the hoists, jacks or floor stands used are in good condition, are properly placed, and that the possibilities of accident are avoided.

REMOVAL PROCEDURE

To remove the transmission from the tractor, proceed as follows:

1. Drain the oil from the transmission, the hydraulic reservoir and the rear end.
2. Remove the hydraulic lines from both the pump and the tractor center housing.

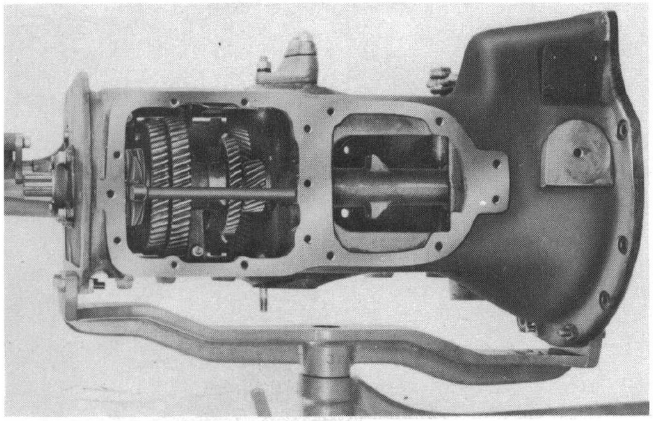


Fig. 1

3. Remove the PTO shaft and the shifter lever.
4. Disconnect the front axle radius rods and remove the step plates, brake and clutch linkage.
5. Disconnect the starter wire and the throttle control rod at the lower end.
6. Place mobile supports under the rear of the tractor engine and the transmission.
7. Remove the bolts that fasten the steering housing and the engine to the transmission case and separate the engine and hood assembly from the transmission.
8. Install the transmission lifting plate and attach the hoist.
9. Place a jack under the front of the center housing.
10. Remove the bolts which secure the transmission case to the tractor center housing.
11. Attach an adaptor to the transmission case and mount the transmission on an engine stand. (Figure 1)

INSTALLATION PROCEDURE

When the transmission assembly is ready to be installed in the tractor, proceed as follows:

1. Fit a new gasket in place on the center housing and secure the transmission case to the tractor center housing.
2. Secure the engine to the transmission case.

NOTE: Removing the starter will facilitate attaching the engine to the transmission case.

3. Install the PTO shaft and shifter lever.
4. Complete the reassembly of the tractor.

Service Job No. 2.

DISASSEMBLY AND ASSEMBLY OF THE TRANSMISSION COVER AND GEAR SHIFT ASSEMBLY

DISASSEMBLY PROCEDURE

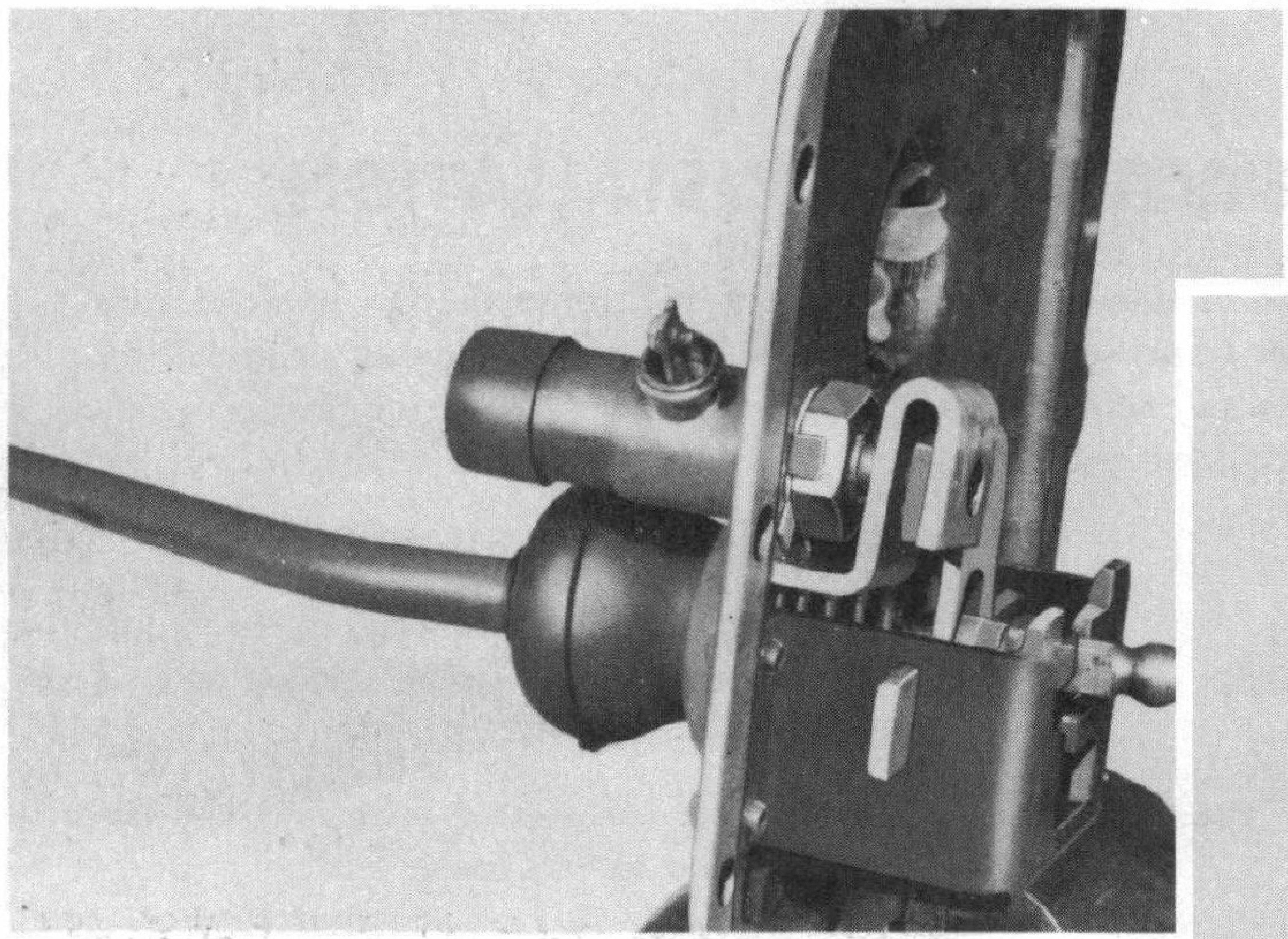


Fig. 2

NOTE: Use new gaskets as required.

1. Remove the starter switch (Figure 2) by removing the nut and lock washer and the safety latch.
2. Compress the spring and remove the spring retainer. (Figure 3)
3. Loosen the shift lever rubber protector from the cover and remove the gearshift lever from the cover assembly.
4. Remove the spring and shifter lock plate from the guide support.
5. Clean and inspect the parts removed and inspect the guide support for wear. Replace worn parts as necessary.

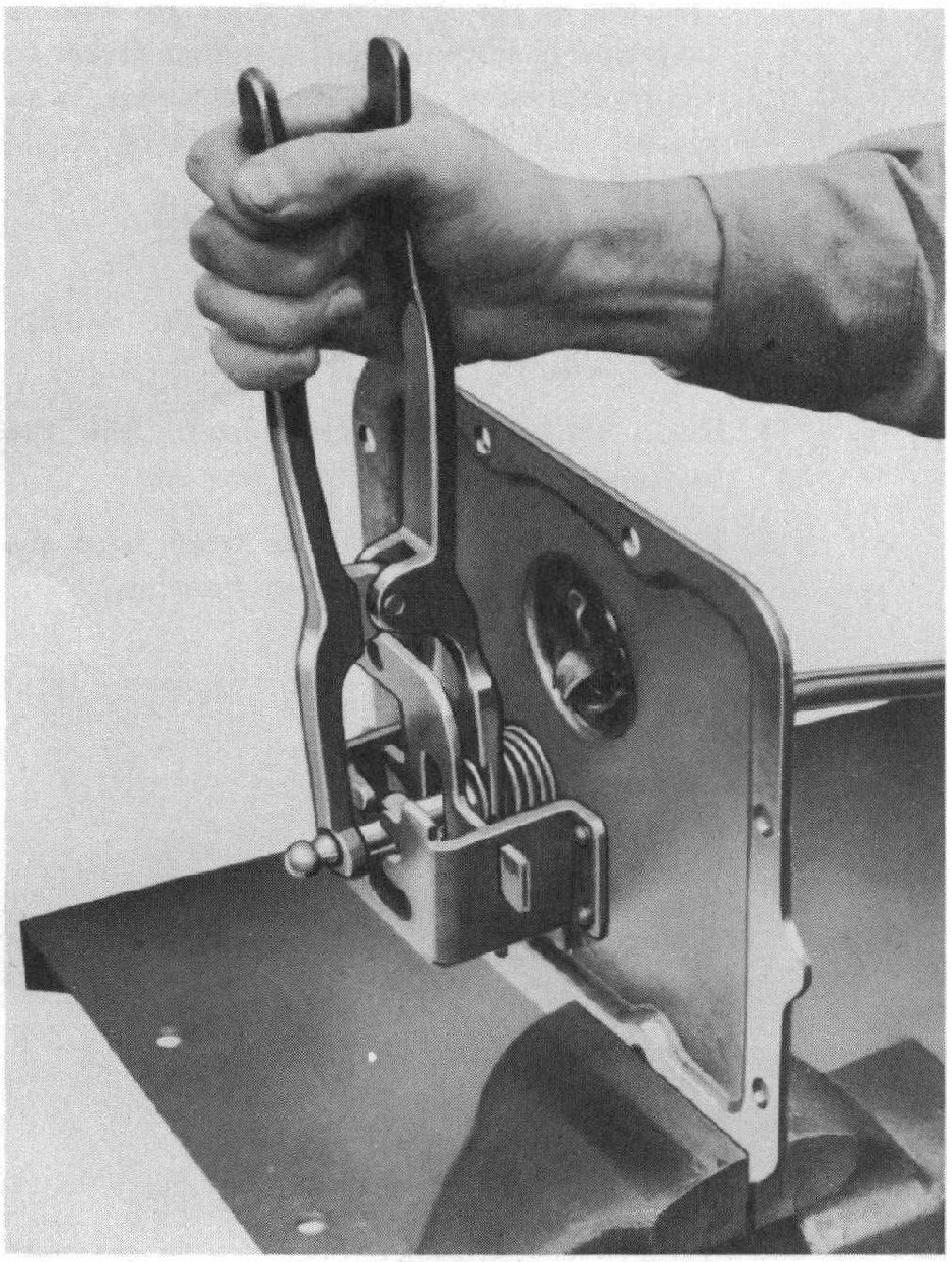


Fig. 3

Service Job No. 3.

MAIN DRIVE GEAR AND SHAFT

REMOVAL PROCEDURE

1. Disconnect the clutch release bearing retaining springs and remove the bearing. (Figure 4)
2. Remove the four (4) cap screws holding the main shaft housing to the transmission case and remove the housing main shaft and drive gear as a unit.

CLEANING AND INSPECTION

1. Clean and inspect the bearings and races for wear.
2. Inspect the main drive gear for wear and damaged teeth.
3. Inspect the splined end of the drive shaft for damage to splines. Replace damaged parts as necessary.

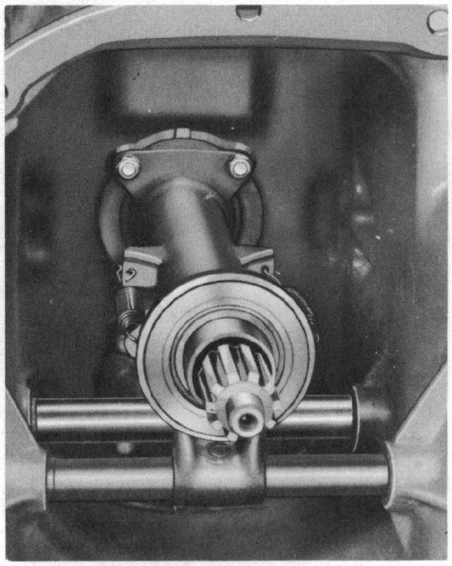


Fig. 4

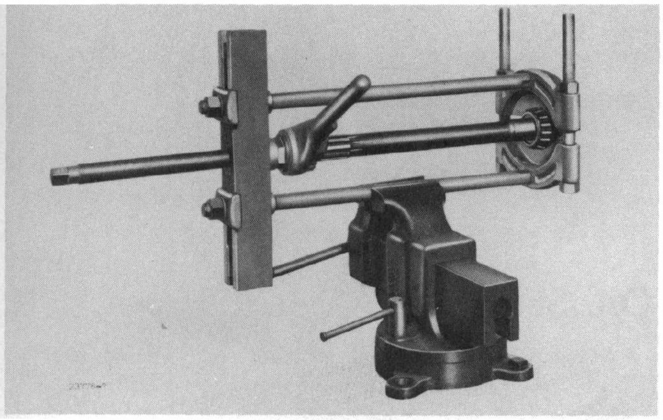


Fig. 5

SERVICING THE MAIN SHAFT ASSEMBLY

1. Remove and replace the bearing on the main shaft, the bearing cup and the oil seal by using the special tools contained in Ford Tractor tool Sets F46 and F47. (Figure 5)

ASSEMBLY PROCEDURE

1. Reassemble the main drive gear and shaft assembly to the transmission by reversing the removal procedure.

   NOTE: Coat the shaft with oil and rotate when assembling to the shaft housing to prevent damaging the oil seal.

Service Job No. 4.

TRANSMISSION MAIN SHAFT

REMOVAL PROCEDURE

1. Loosen the locknut on the upper shift fork. Back off the screw and slide the upper shifter rail out of the transmission and remove the fork.
2. Remove the hex head pivot screws from each side of the housing and lift out the shift plates.
3. Remove the PTO shift rail stop and slide the shift rail rearward so the rear bearing retainer will clear.
4. Remove the four (4) cap screws and remove the rear bearing retainer.

   NOTE: Keep the shim pack together to facilitate replacement.

5. Disconnect the clutch release bearing retaining springs and remove the bearing.
6. Remove the four (4) cap screws from the main drive shaft housing and remove the drive shaft and housing as a unit.

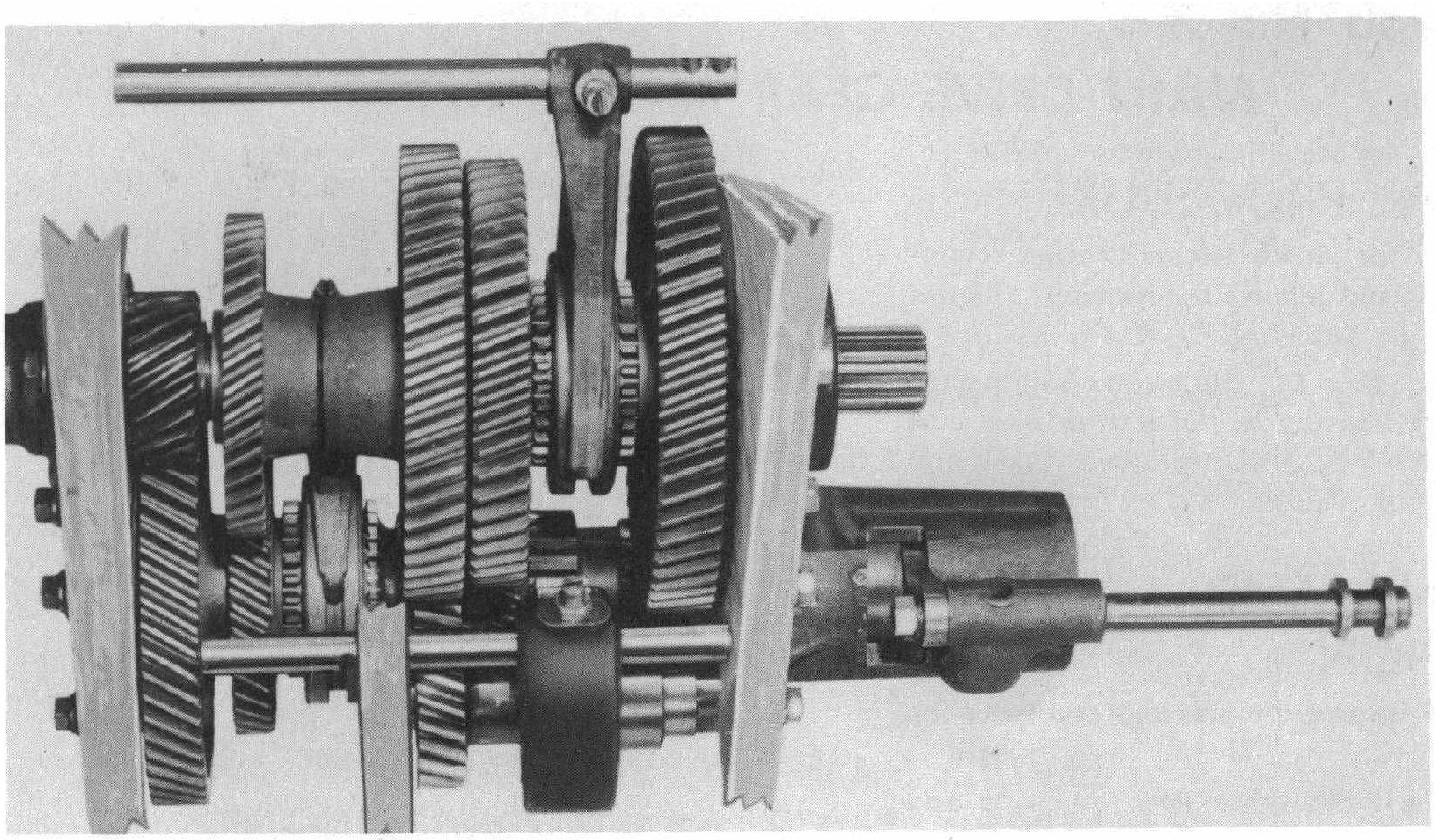


Fig. 6

7. Remove the reverse idler shift rail and lay the fork over against the side of the housing. (Figure 6)

8. The transmission main shaft gear cluster can then be lifted out as a unit.

CLEANING AND INSPECTION

1. Clean the bearings and gears with grease solvent.

2. Inspect the bearings and gear teeth for wear.

MAIN SHAFT AND GEAR CLUSTER DISASSEMBLY

1. Use the Ford Tractor special service tools contained in Sets F46 and F47 (Figure 7) to remove and replace the bearings and gears on the transmission main shaft.

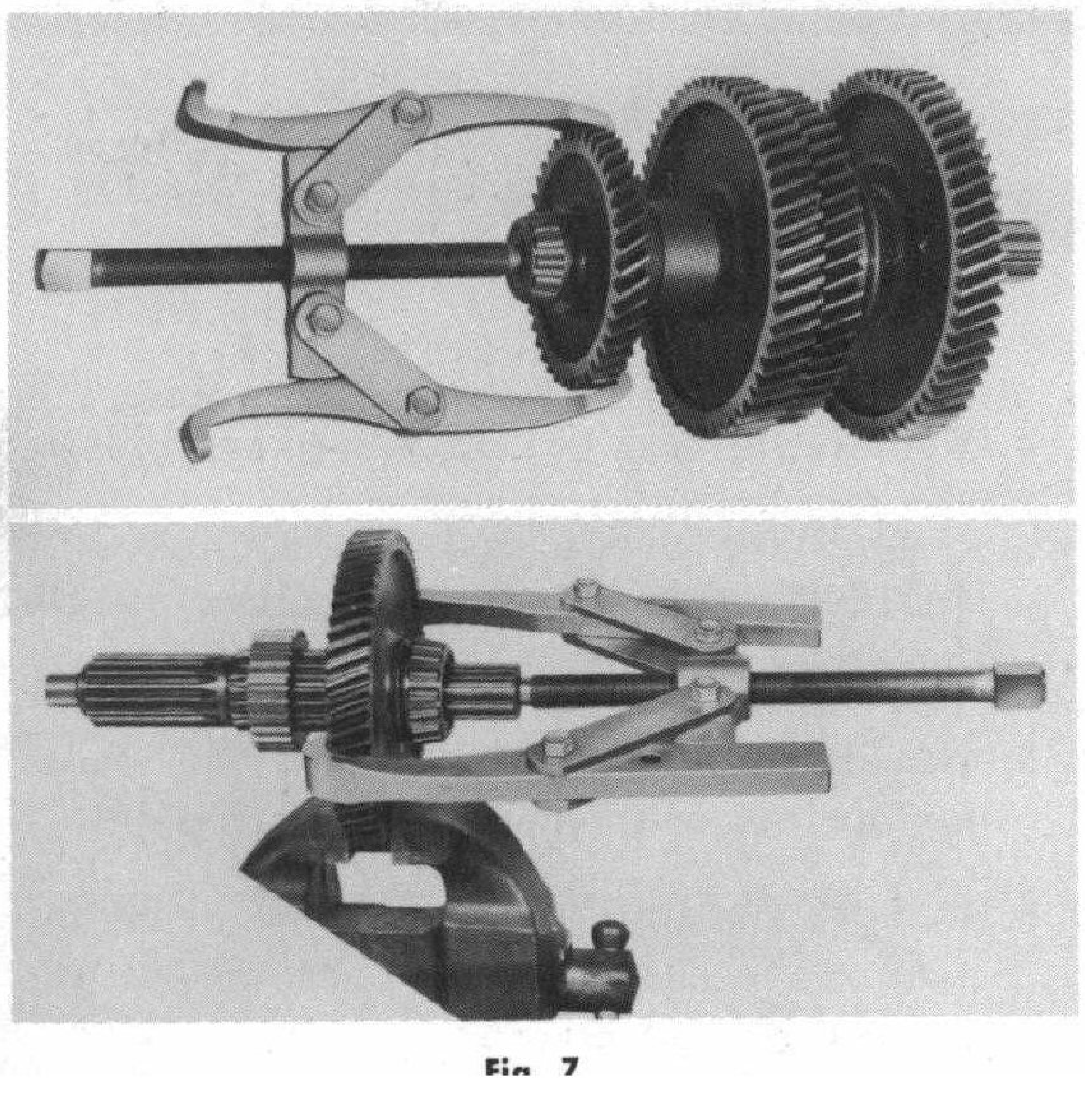


Fig. 7

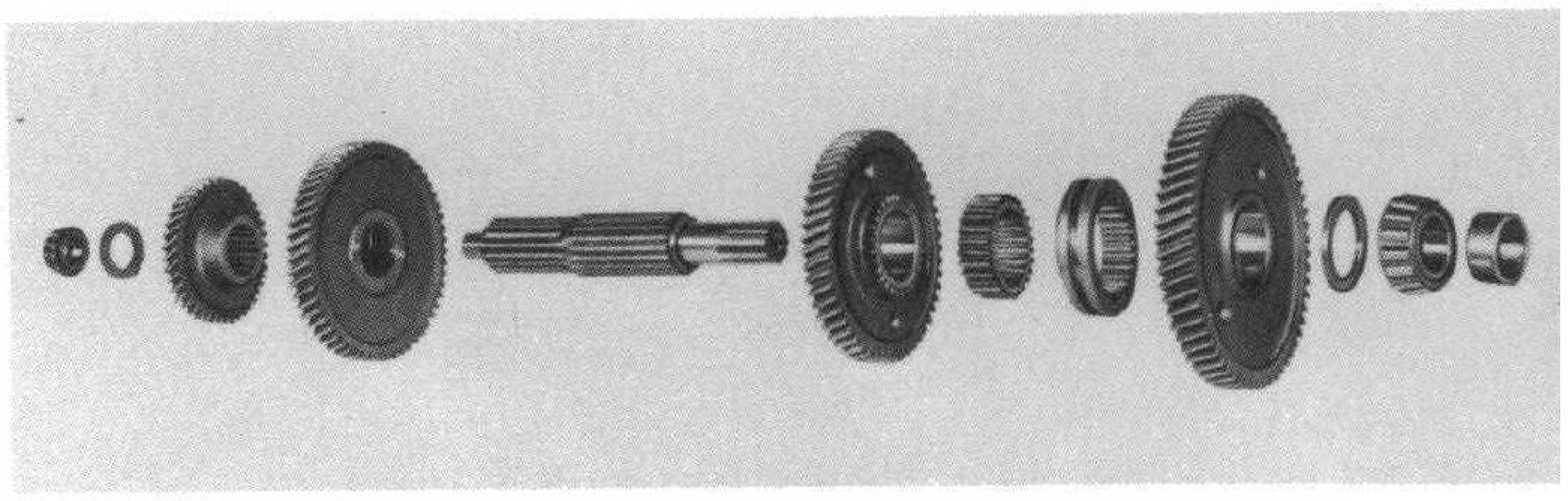


Fig. 8

OIL SEAL REPLACEMENT

1. The oil seal in the rear bearing retainer can be driven out and replaced by using a suitable sleeve and press. (Figure 9)

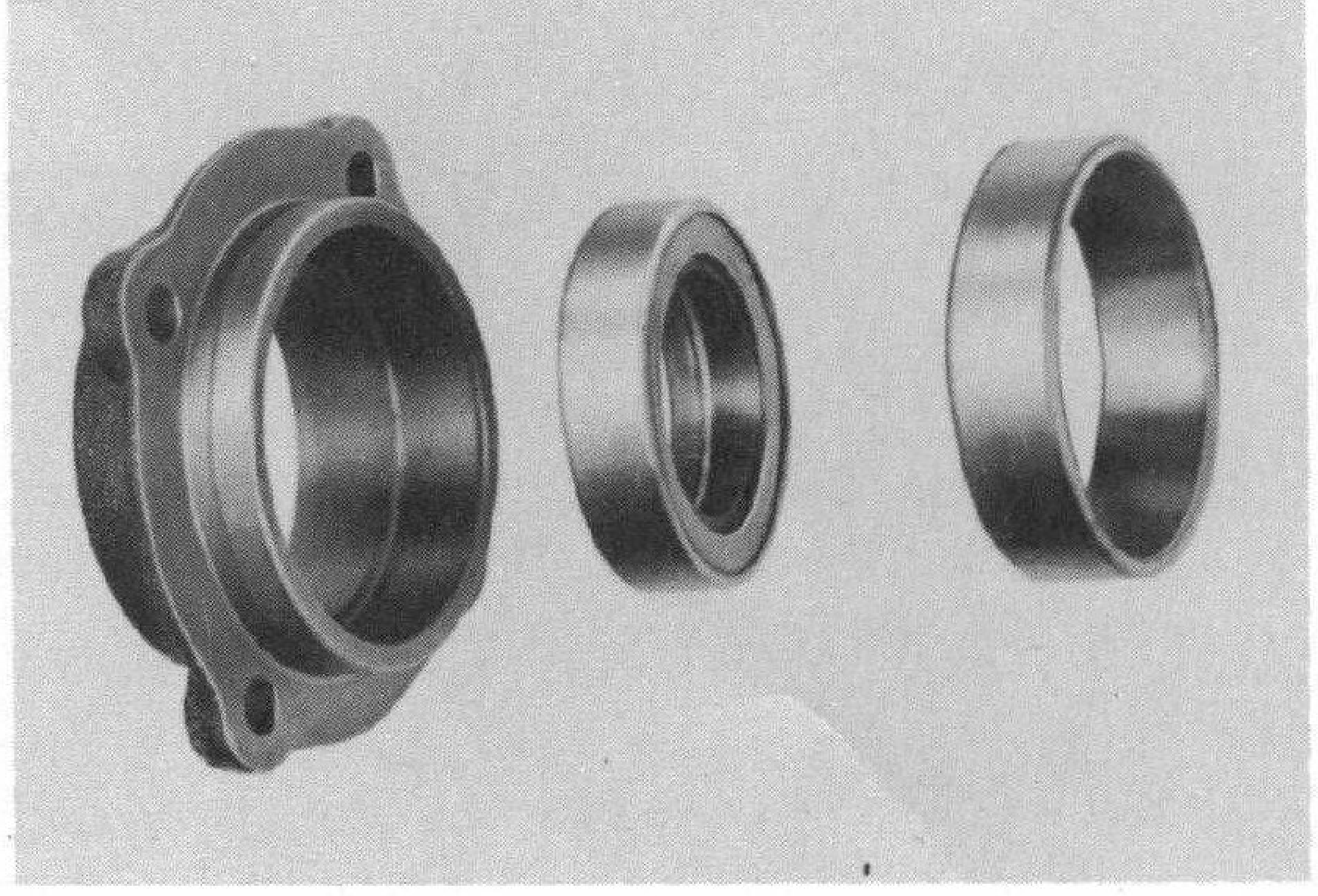


Fig. 9

REASSEMBLY PROCEDURE

1. To install the transmission main shaft in the transmission, reverse the disassembly procedure.

   ***NOTE:** Be sure to replace the shims between the rear bearing retainer and transmission housing. Remove or add shims as necessary to give a main shaft preload of 20 to 35 in. lbs. (Figure 10) If the countershaft preload is on the low side, the main shaft preload should also be on the low side and vice versa.*

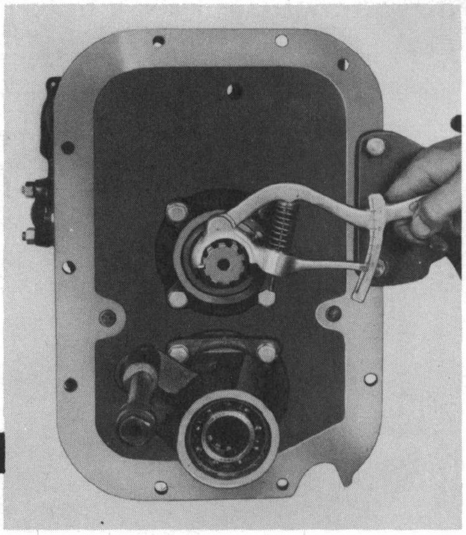


Fig. 10

Service Job No. 5.

TRANSMISSION COUNTERSHAFT

REMOVAL PROCEDURE

1. After the main shaft has been removed, the transmission countershaft can be removed by removing the countershaft shifter rail and fork, the front bearing retainer and the PTO shifter assembly. (Figure 11)

   ***NOTE:** Keep the shim pack together to facilitate replacement.*

2. Remove the countershaft and gear cluster as a unit.

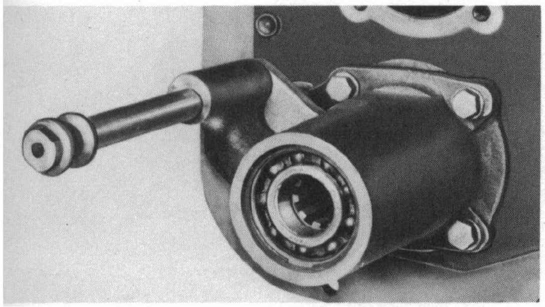


Fig. 11

CLEANING AND INSPECTION

1. Clean the bearings and gears with grease solvent.
2. Inspect the bearings and gears for wear.

COUNTERSHAFT AND GEAR CLUSTER DISASSEMBLY

1. Use the Ford Tractor special service tools contained in Sets F46 and F47 (Figure 12) to remove and replace the bearings and gears on the countershaft.

   ***NOTE:** See PTO section for oil seal replacement.*

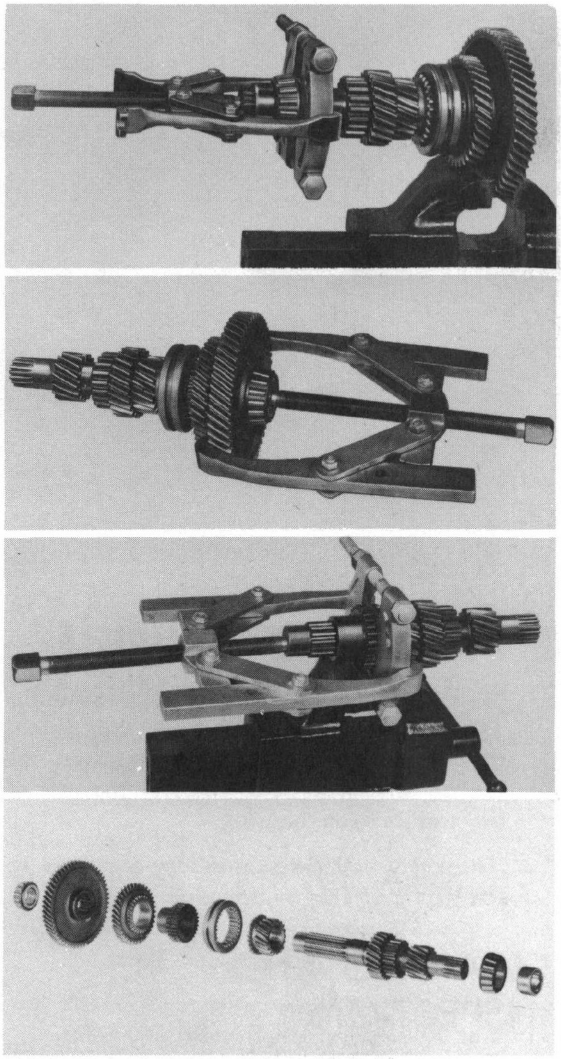


Fig. 12

REASSEMBLY PROCEDURE

1. To install the countershaft in the transmission, reverse the disassembly procedure.

   NOTE: Be sure to install the shim pack between the PTO shifter assembly and the transmission case. Remove or add shims as necessary to give a preload of 15 to 30 in. lbs. (Figure 13)

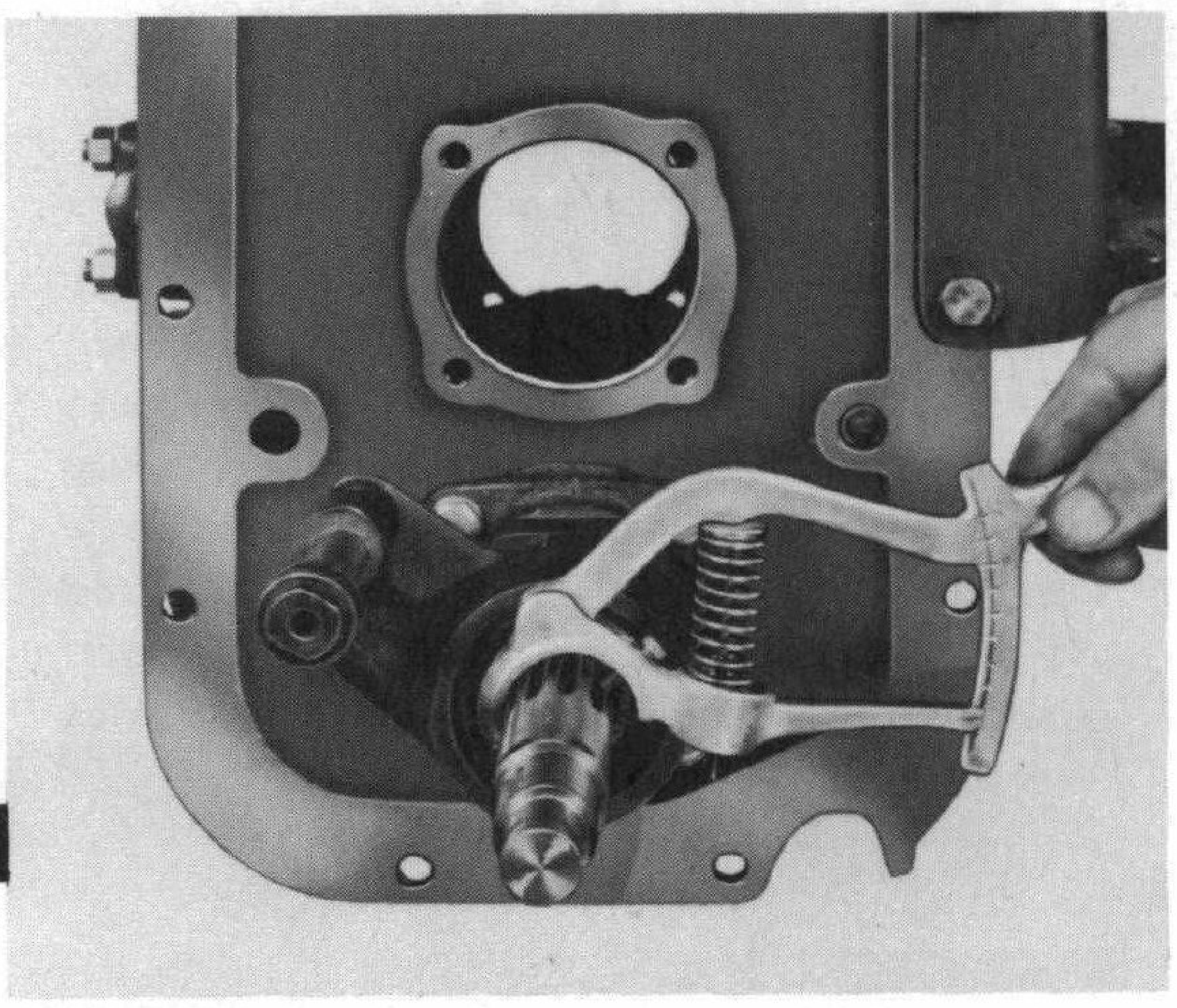


Fig. 13

Service Job No. 6.

REVERSE IDLER SHAFT

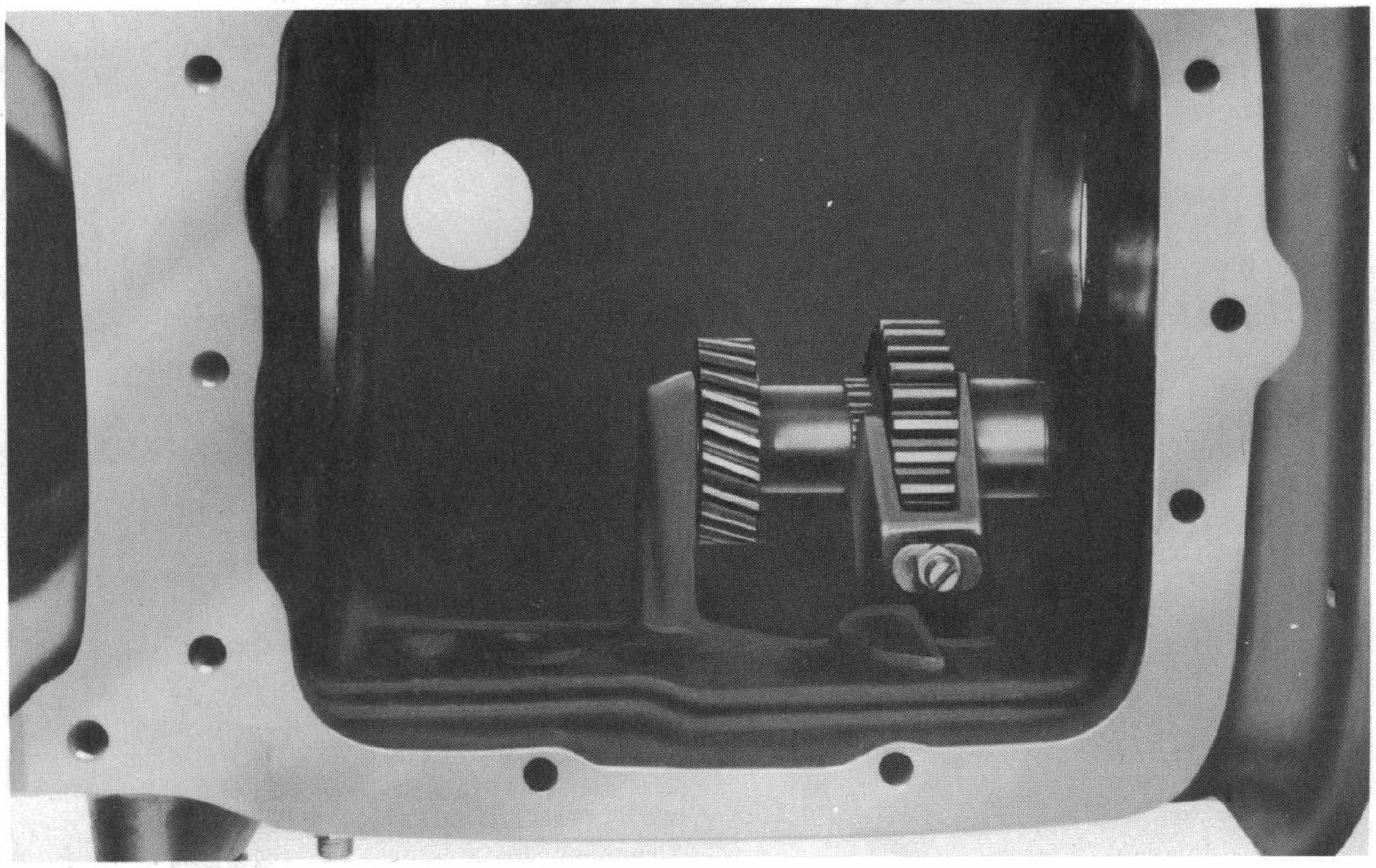


Fig. 14

REMOVAL PROCEDURE

1. With the main shaft, countershaft and the PTO shifter assembly removed (Figure 14), the shifter fork can be lifted out and the reverse idler shaft will slide out the rear of the transmission housing.
2. The gears and thrust washers can then be lifted out of the transmission case.

CLEANING AND INSPECTION

1. Clean the gears in grease solvent and inspect them for wear and damaged teeth.

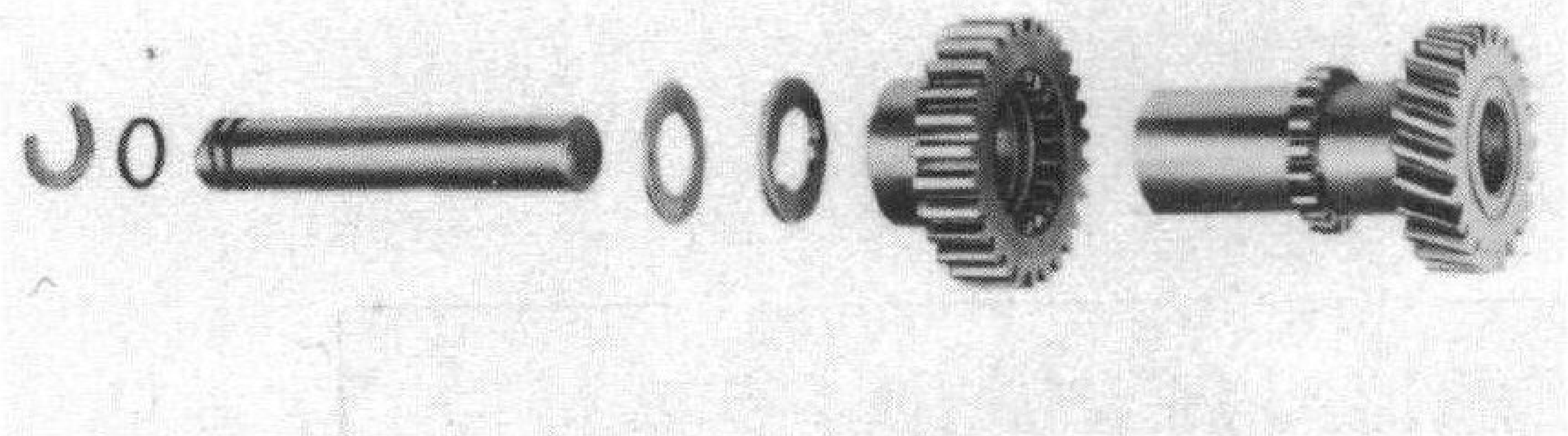


Fig. 15

REPLACEMENT PROCEDURE

1. Position the gears and thrust washers in the transmission housing (Figure 15) and slide the reverse idler shaft into position.

Service Job No. 7.

SERVICING THE PTO SHIFTER ASSEMBLY

The PTO Shifter Assembly provides a means for engaging and disengaging the power take-off shaft from the transmission countershaft. (Figure 16)

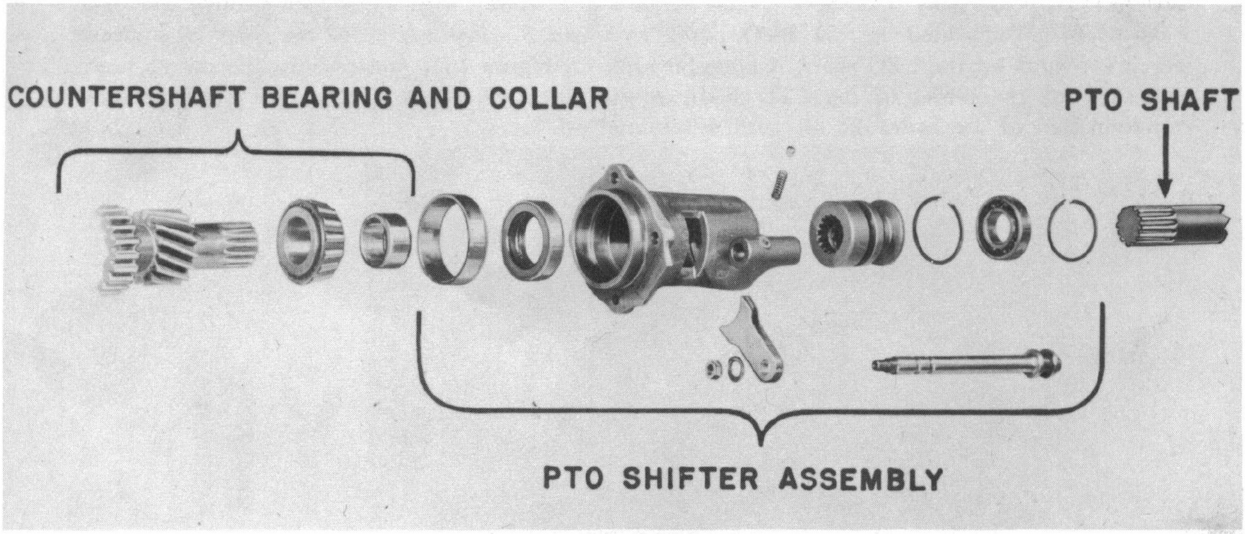


Fig. 16

REMOVAL PROCEDURE

1. Drain the oil from the differential, transmission and hydraulic reservoirs.
2. Remove the four (4) cap screws in the PTO cover and remove the PTO shaft assembly from the rear of the tractor.
3. Remove the PTO shifter plate and lever.
4. Disconnect the running boards at the rear and the left-hand brake rod.
5. Disconnect the hydraulic lines from the center housing, remove the bolts and separate the transmission from the center housing.

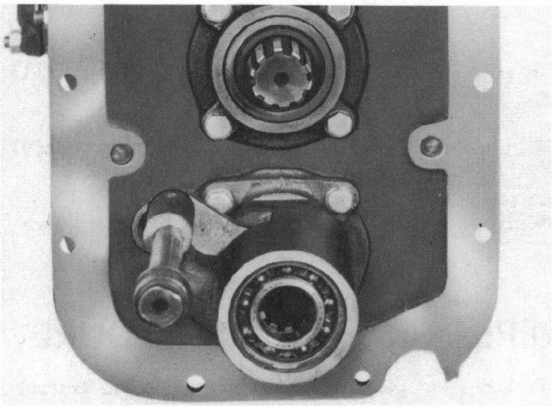


Fig. 17

6. The PTO shifter assembly can then be removed by removing the four (4) cap screws that bolt it to the rear of the transmission housing. (Figure 17)

NOTE: Keep the shim pack together to facilitate replacement.

DISASSEMBLY PROCEDURE

1. Remove the PTO shift rail stop and then remove the shift rail, interlock ball and spring. (Figure 16)
2. Remove the outer snap ring from the rear of shifter assembly and lift out the rear bearing.
3. Remove the inner snap ring and remove the clutch sleeve.
4. The front bearing race and oil seal can be removed with a press and suitable sleeve, or by using the Ford Tractor special tools contained in Sets F46 and F47.

ASSEMBLY PROCEDURE

1. Assemble the PTO shifter assembly by reversing the disassembly procedure.

NOTE: Be sure to install the shim pack and check the transmission preload 20 to 30 in. lbs. (Figure 10)

Service Job No. 8.

THE PTO SHAFT ASSEMBLY

The PTO shaft provides a direct drive from the transmission countershaft to the rear of the center housing for attaching the belt pulley, PTO adaptor or other power-driven equipment.

The PTO shaft assembly consists of a shaft and sleeve assembly with a 1⅛-inch splined end. The PTO shaft is supported in the PTO cover by a ball bearing secured to the shaft by a sleeve which is shrunk on the PTO shaft. A brass bushing (A-Figure 18), pressed into the center housing, supports the center of the PTO shaft. A grease seal (B-Figure 18), at this point, prevents contamination of the hydraulic oil with differential oil.

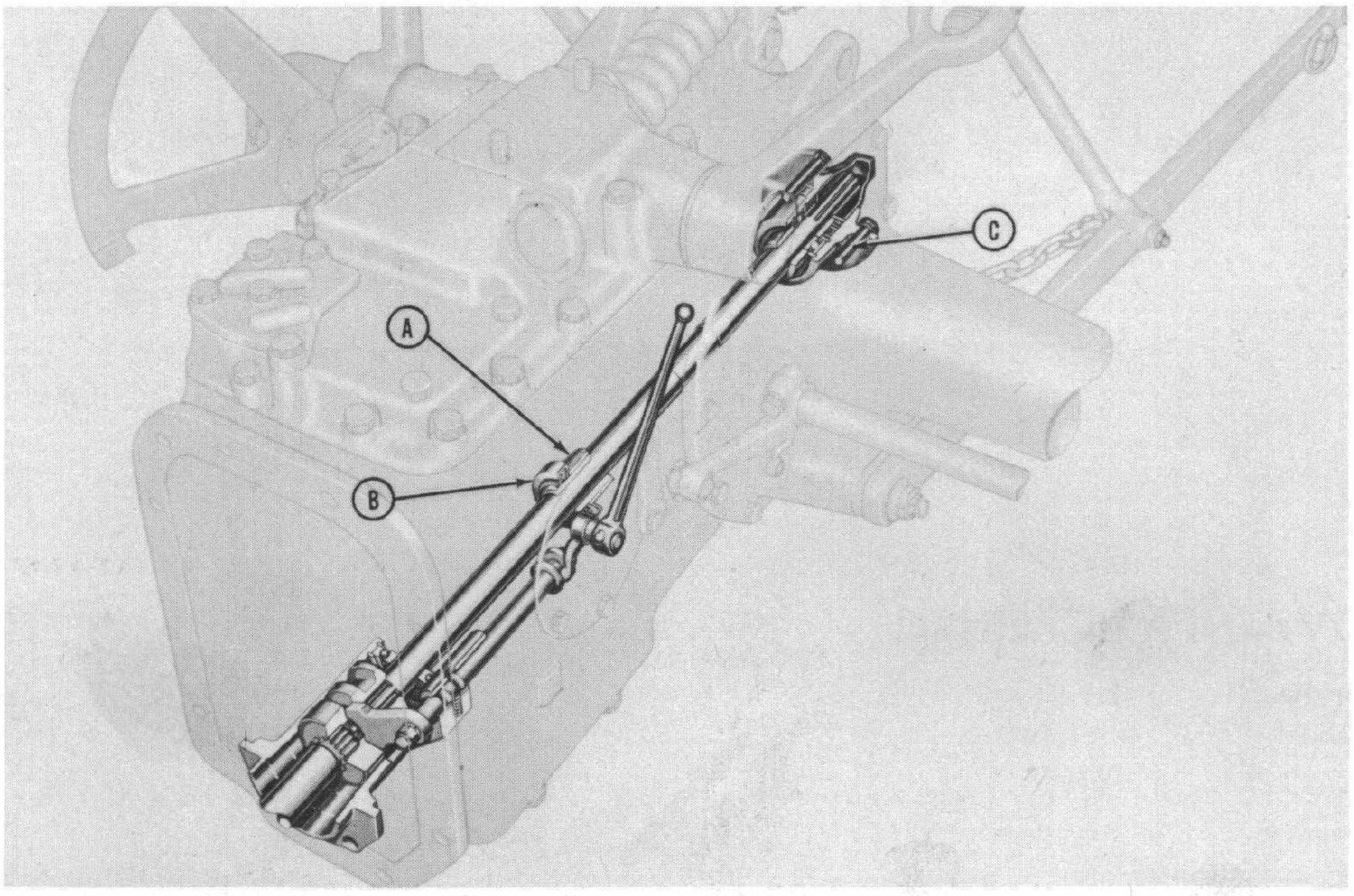


Fig. 18

REMOVAL PROCEDURE

1. Remove the four (4) cap screws (C-Figure 18) from the PTO cover and remove the PTO shaft assembly from the rear of the tractor.

DISASSEMBLY PROCEDURE

1. Remove the outer snap ring from the PTO cover. Attach a puller and pull the cover assembly from the transmission shaft.
2. The PTO cover, when removed, will contain the oil seal and inner snap ring.
3. Remove the inner snap ring and drive the oil seal from the PTO cover.
4. The bearing is removed from the PTO shaft by splitting the sleeve with a cold chisel and then pulling the bearing from the shaft.
5. The oil seal and bearing in the center housing can be serviced by removing and replacing with new units.
6. Replace by using a sleeve of suitable size and driving into place.

PTO SHAFT ASSEMBLY

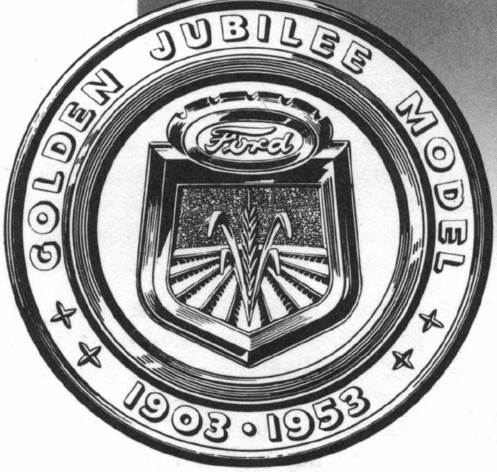
1. Install the ball bearing on the PTO shaft.
2. Heat the PTO sleeve and slide into position on the PTO shaft.
3. Install the inner snap ring in the PTO cover and press cover onto shaft.
4. Using a sleeve of suitable size, drive oil seal into place.
5. Replace the outer snap ring and shaft cover.

REPLACEMENT PROCEDURE

1. Use new gaskets and reassemble the tractor transmission to the center housing. Install PTO shaft by reversing the disassembly procedure.

Section III

HYDRAULIC SYSTEM



Section III

HYDRAULIC SYSTEM

Service Job No. **Page**

1. Removal and Disassembly of Hydraulic Pump 31
2. Assembly and Installation of Hydraulic Pump 33
3. Removing the Hydraulic Lift Cover Assembly 34
4. Removal of the Manifold Plate and Valves from the Hydraulic Lift Cover 35
5. Removal and Installation of the Relief Valve 36
6. Attaching the Ram Cylinder and Valve Housing to the Lift Cover and Installing the Lift Cover on the Tractor . . 36
7. Constant Draft and Implement Position Control Adjustments 37

Service Job No. 1.

REMOVAL AND DISASSEMBLY OF HYDRAULIC PUMP

The hydraulic pump is a precision unit. In working with it, extreme care must be exercised to avoid damage of its parts. When it is necessary to hold certain parts in a vise, the vise should be fitted with soft face jaws. The use of two small wooden boxes for holding parts will be very helpful in the disassembly, cleaning, inspection, and assembly of the hydraulic pump. One box should be used to put parts in as the pump is disassembled; the second, used for parts that have been cleaned, inspected and ready for assembly. Damaged and worn parts should be discarded immediately and the new parts placed in the second container.

This hydraulic pump is a rotary type, positive displacement pump. In operation, this type of pump delivers fluid continuously. If the discharge line should become plugged, pressure will build up in the pump until it fails mechanically. The rotor in this pump contains a number of slots into which movable vanes are fitted. As the rotor revolves, the vanes are moved outward by centrifugal force against the surface of an oval shaped ring. The vanes follow the contour of this surface. In addition to the centrifugal force, liquid pressure behind the vanes also helps to hold them against the surface. The pump vanes do not move inward or outward unless they are in hydraulic balance. There is no cantilever action acting on vanes when they are moving in or out of their rotor slots.

This pump is designed so that it drains internally. This eliminates the necessity of having an external drain which must be returned to the reservoir.

REMOVAL PROCEDURE

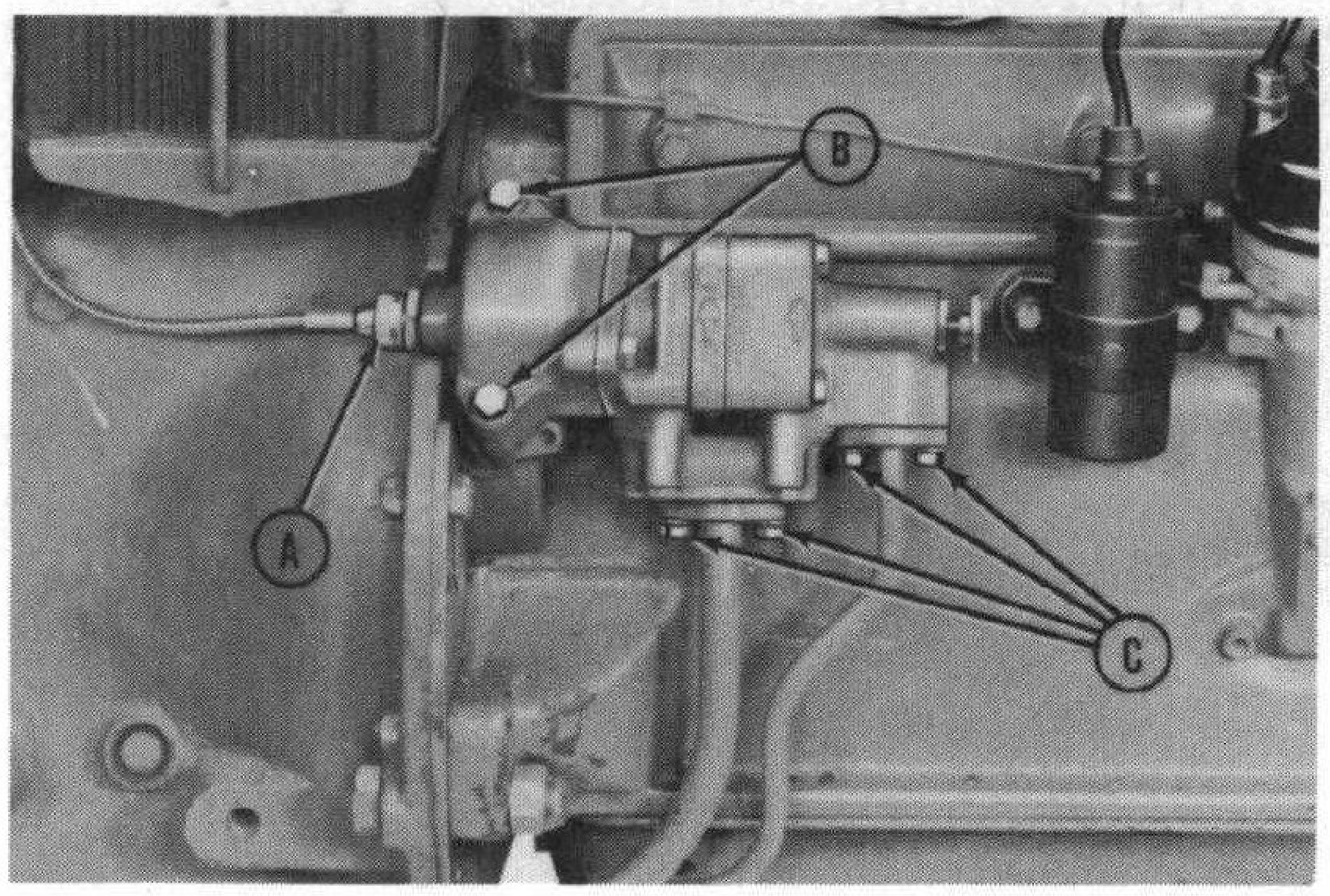


Fig. 1

1. Disconnect the Proof-Meter cable from the pump. (A-Figure 1)
2. Disconnect the hydraulic lines from the pump. (C-Figure 1)
3. Remove the two (2) cap screws (B-Figure 1) holding the pump to the engine block and lift the pump from its mounting.
4. Remove the gasket.

DISASSEMBLY PROCEDURE

1. Place the pump body in a vise with soft face jaws and disassemble the pump in the order of the indexed numbers. (Figure 2)

CAUTIONS:

(a) Remove gear No. 4 (Figure 2), and housing No. 5 from shaft No. 26 by carefully driving housing No. 5 off with a soft face hammer.

(b) Remove bearing No. 27 (Figure 2), and shaft No. 26 as a unit from the pump body No. 31.

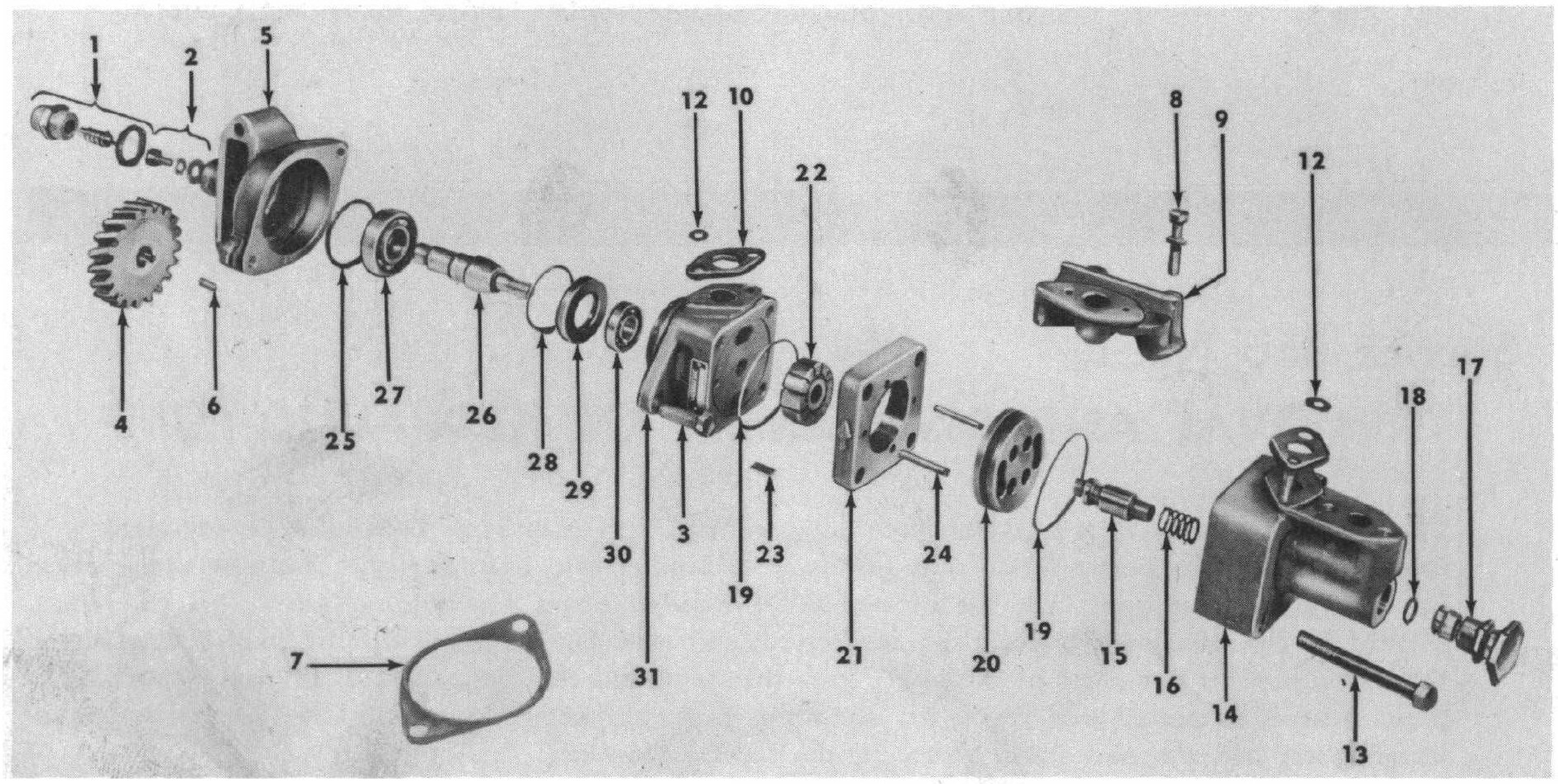


Fig. 2

1. Proofmeter Drive
2. Proofmeter Drive
3. Cap Screw
4. Gear
5. Mounting Housing
6. Square Key
7. Gasket
8. Cap Screw
9. Manifold
10. Gasket
11. Gasket
12. Spacer, Gasket
13. Cap Screw
14. Cover
15. Valve, Flow Control
16. Spring
17. Flow Control Adjust
18. O Ring
19. O Ring
20. Pressure Plate
21. Ring, Cam
22. Rotor
23. Vane, Kit
24. Pin, Dowel
25. Snap-ring
26. Shaft
27. Bearing
28. Spacer
29. Seal-Shaft
30. Bearing
31. Body

Service Job No. 2.

ASSEMBLY AND INSTALLATION OF HYDRAULIC PUMP

Thorough cleaning and careful inspection of all parts for wear, fit or damage are an important part of the assembly procedure. The shaft seal and all "O" rings should be replaced on all repair jobs to assure efficient pump operation. Worn or damaged parts are easily removed and replaced. The housing is not subject to wear. Wear that occurs in the vanes is automatically taken up without appreciable change in performance.

ASSEMBLY PROCEDURE

1. Clean, inspect and replace all worn or damaged parts.
2. Place the pump body (31-Figure 2) in a vise and assemble the pump. Maintain all parts in their relationship as shown. (Figure 2)

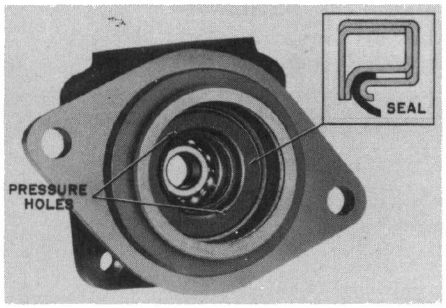


Fig. 3

CAUTIONS:

(a) Assemble parts No. 30, 29, and 28 (Figure 2), respectively, into part No. 31 before installing the unit made up of parts No. 26 and 27.

(b) Install shaft seal No. 29 into the body No. 31 (Figure 2) with the pressure holes facing out of the pump body. (Figure 3) The shaft seal should be driven in with a tool that contacts only the O.D. of the seal.

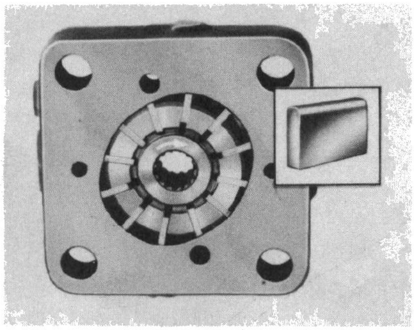


Fig. 4

(c) Assemble vanes No. 23 with the arched edge outward riding on the inside surface of the cam ring. (Figure 4) Note the shape of the vane as shown in the insert. (Figure 4)

(d) Install the cam ring No. 21 (Figure 2) with arrows on the cam ring pointing to the left or counterclockwise when facing the shaft end of the pump.

3. Mount the pump on the tractor engine. Use a new gasket and tighten the two (2) cap screws securely.
4. Connect the hydraulic lines to the pump as shown. (Figure 1)
5. Connect the Proof-Meter cable to the pump.
6. Check pump operation.

The following information is provided to serve as reference in checking pump operation and in trouble-shooting and servicing the pump.

Pump Not Delivering Oil:

1. Be sure the pump ring is properly positioned in relation to shaft rotation.
2. Check reservoir oil level.
3. Oil intake pipe or suction filter plugged.
4. Air leak in suction line.
5. Pump shaft turning too slowly to prime.
6. Oil viscosity too heavy to prime.
7. Broken pump shaft or rotor.
8. Head improperly adjusted.
9. May be necessary to bleed air by loosening acorn nut on oil return line from cylinder to sump side of tractor.

Pump Not Working at Desired Pressure:

1. Pump not delivering oil for any of the above reasons.
2. Relief valve setting not high enough.
3. Relief valve stuck open.
4. Relief valve leaking.
5. Leak in hydraulic control system.
6. Free recirculation of oil to tank being allowed through system.
7. Air trapped in the pump or suction line.

8. Vane or vanes stuck in rotor slots.

9. Pump cover loose.

10. Broken core passages in pump body.

11. Pump seizure caused by:
  a. Failure to prime
  b. Faulty adjustment
  c. Dirty oil
  d. Starting cold pump with hot oil or vice versa

Pump Making Noise:

1. An air leak in the system on the intake side of the pump will produce a rattling noise.

2. A restriction in the system on the intake side of the pump will produce a squealing noise.

3. Other causes of noise in the pump are as follows:
  a. Partially clogged, intake line, intake filter or restricted intake pipe
  b. Small air leak at pump intake piping joints
  c. Air leak at pump shaft packing
  d. Stuck pump vane—sticky pump vanes
  e. Relief valve chattering
  f. Pump head too loose, or a faulty head gasket
  g. Coupling misalignment
  h. Restriction pulled into intake cores (rag or paper)
  i. Air bubbles in intake oil
  j. Tank air vent plugged
  k. Pump running too fast
  l. Oil too heavy
  m. Poor quality oil causing air bubbles

External Leakage Around Pump:

1. Shaft seal worn.

2. Suction pipe connection.

3. Damaged gasket or "O" ring seals.

Service Job No. 3

REMOVING THE HYDRAULIC LIFT COVER ASSEMBLY

The hydraulic lift cover assembly and the housing in which the valves are located are removed from the tractor as a single unit.

It is necessary to remove the lift cover assembly to make adjustments necessary for proper operation of the hydraulic system, to service the unit, and, of course, to do work inside the tractor center housing.

REMOVAL PROCEDURE

1. Remove the tractor seat and disconnect the hydraulic lift links from the lift arms and free the main control spring yoke from the 3-hole rocker at the rear of the tractor.

2. Push the hydraulic lift arms down to their lowest position to force as much oil as possible out of the ram cylinder and the valves.

3. Remove the acorn nut from the right-hand side of the center housing and the threaded retainer bushing to which the nut is attached. (Figure 5)

NOTE: This nut must be removed and the bushing backed off before the lift cover is removed to avoid damaging the back pressure valve seal. This is important.

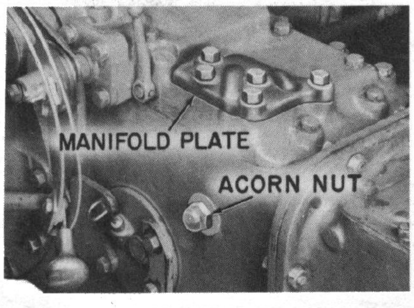


Fig. 5

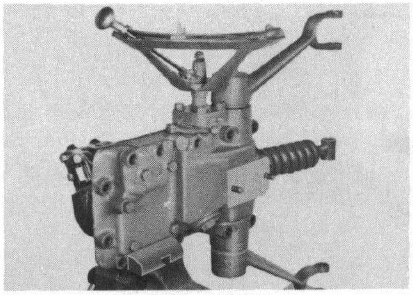
4. Remove the fourteen (14) cap screws which secure the hydraulic lift cover to the tractor center housing.

5. Free the lift cover from the center housing and lift it off the tractor.

NOTE: The back pressure valve and the exhaust tube attached to it will remain in the tractor center housing. The rubber seal, against which the face of the valve rests, will remain in the ram cylinder and valve housing.

6. Place the lift cover assembly in a vise. (Figure 6) Be sure the vise is fitted with soft metal jaw faces.

Fig. 6



Service Job No. 4.

REMOVAL OF THE MANIFOLD PLATE AND VALVES FROM THE HYDRAULIC LIFT COVER

Caution should be exercised in the removal and disassembly of these parts so as to avoid damaging the highly finished surfaces. It is recommended that all parts be wiped off as they are removed and placed on a clean cloth to protect the parts and keep them in order.

REMOVAL PROCEDURE

Removing the Manifold Plate:

1. Remove the three (3) cap screws which hold the plate in place. (Figure 6) Note that these cap screws have fine threads.
2. Remove the manifold plate.
3. Remove the metal shim from the machined surface of the lift cover. Note the two large and two small "O" ring rubber seals.

Removing the Valve and Ram Cylinder Housing:

NOTE: There are several Allen Screws in the casting which houses the valves and the ram cylinder. These screws serve to plug holes needed in manufacturing. Ordinarily, they need not be removed.

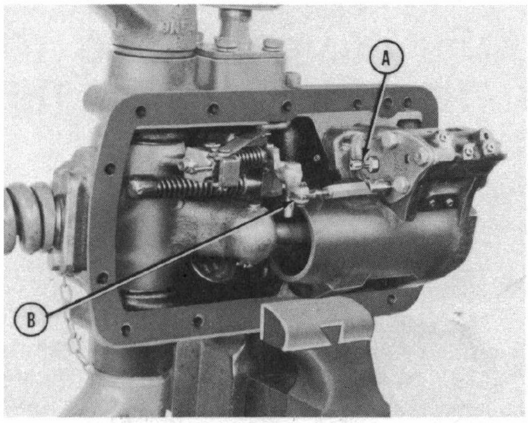


Fig. 7

1. Disconnect the control valve linkage from the control arm. (B-Figure 7)
2. Remove the manifold plate.
3. Remove the two (2) cap screws located in the left front edge of the lift cover. Because of the weight of the housing, caution should be exercised at this point to avoid dropping it.
4. Remove the gaskets which form the seal between the lift cover and the housing.
5. Wipe the surfaces clean and free from oil.

REMOVING THE VALVES FROM THE HOUSING

Removing the Check Valve:

1. Remove the safety and check valve assembly by turning the 11/16-inch nut out. (A-Figure 7)
2. Remove the check valve seat located in the pump end of the housing (B-Figure 8) by first removing the baffle and deflector plates from the pump end of the housing and driving the valve seat out forward.

   NOTE: When the baffle and end plate are removed from the pump end of the housing, the control valve spring will come out. (C-Figure 8)

Removing the Control Valve:

1. Disconnect the control valve linkage from the control arm. (B-Figure 7)
2. Remove the plates from both ends of the valve housing and pull the control valve and the spring out. Note that this valve is in a full-length bushing.
3. Wipe the valve and spring free from oil.

Removing the Bypass Valve:

1. Remove the plate from each end of the valve housing.
2. Remove the valve and the plug from the front end of the valve chamber (A-Figure 8) by pushing forward with a small drift punch.
3. Wipe the valve and the plug free from oil.

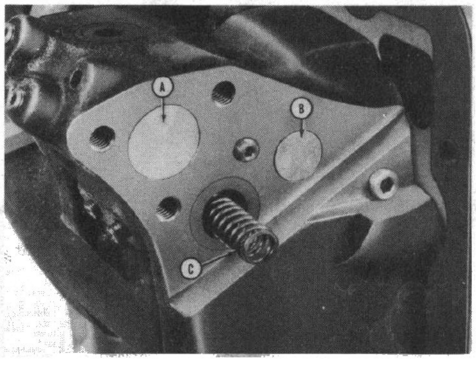


Fig. 8

Service Job No. 5.

REMOVAL AND INSTALLATION OF THE RELIEF VALVE

The relief valve is set for a pressure of 2,000 p.s.i. This valve is located in the forward and lower part of the tractor center housing. (Figure 9) The valve components are not serviceable. It must be replaced as a complete new unit.

REMOVAL PROCEDURE

1. Drain the hydraulic oil from the reservoir.
2. Remove the pressure line from the base of the tractor center housing and the pump.
3. Remove the lift cover from the tractor.
4. Remove the spring clip from the shank of the valve.
5. Drive the valve downward with a soft mallet and a block of wood.

INSTALLATION PROCEDURE

1. Start the relief valve shank up into the hole from the under side of the tractor center housing.
2. Drive the valve into place with a suitable soft material punch.
3. Fix the retainer clip in place on the valve.

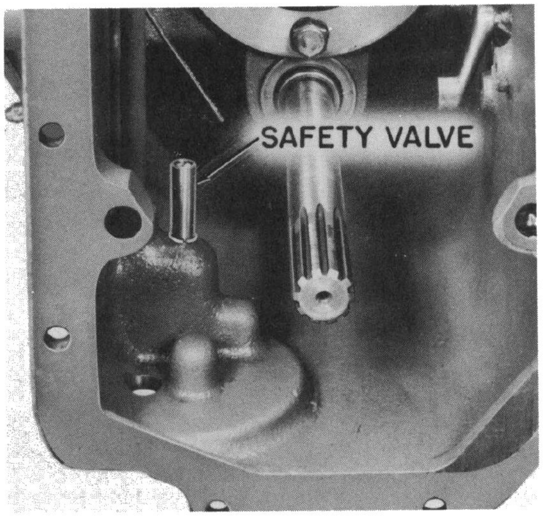


Fig. 9

Service Job No. 6.

ATTACHING THE RAM CYLINDER AND VALVE HOUSING TO THE LIFT COVER AND INSTALLING THE LIFT COVER ON THE TRACTOR

Care must be exercised in the assembly and installation of these units. Make sure that all parts are thoroughly cleaned, that all gaskets are replaced and properly positioned, and that all bolts are securely tightened.

ASSEMBLY PROCEDURE

1. Attach the ram cylinder and valve housing to the lift cover. In doing this, be sure the lift ram arm is inside the cylinder and that the gaskets are in place. When the manifold plate is off, the housing is held by only two (2) cap screws on the front, left side of the lift cover. (Figure 10)

   NOTE: Before the five (5) bolts which secure the housing to the lift cover are finally torqued, be sure that the housing is forward as far as possible. This is important in maintaining proper adjustment.

2. Connect the control valve to the control linkage.
3. Secure the manifold gasket and cover plate in place on the lift cover. Use the three (3) cap screws with fine threads. Be sure the four (4) rubber "O" rings are in place in the steel gasket.

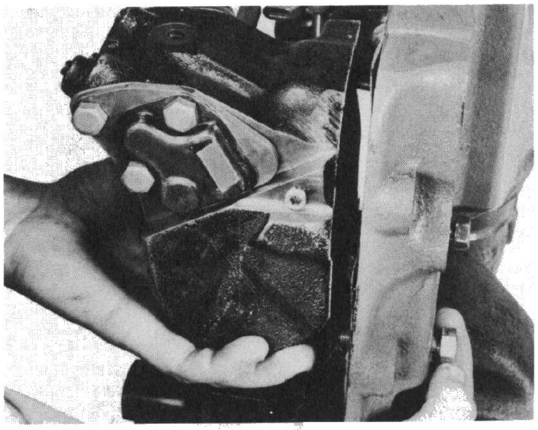


Fig. 10

4. Start the threaded bushing for the back pressure valve into the hole in the right side of the tractor center housing.
5. Position the back pressure valve and tube in place with the snap ring end of the valve pushed into the bushing, so the snap ring holds the valve in the bushing.
6. Fit the back pressure valve rubber washer in place in the side of the valve housing. (Figure 10)
7. Fit the lift cover assembly in place on the tractor center housing and secure with cap screws. Make sure the gasket is properly positioned on the center housing.
8. Turn the back pressure valve bushing firmly in, to seal the valve against the rubber washer.
9. Fit the copper washer over the protruding part of the bushing and turn the acorn nut onto the bushing and firmly against the tractor center housing. (Figure 5)
10. Secure the hydraulic lines to the base of the center housing.
11. Attach the tractor lift rods to the hydraulic lift arms.
12. Secure the three-hole rocker to the main control spring yoke.
13. Mount the tractor seat in place.
14. Fill the hydraulic reservoir with eight (8) quarts of oil. For temperatures above 32°F., use Ford Motor Company oil 4864A (approximately S.A.E. No. 30 motor oil). For temperatures below 32°F., use Ford Motor Company oil 4864C (approximately S.A.E. No. 10 motor oil).
15. Test the system for operation and leaks.

Service Job No. 7.

CONSTANT DRAFT AND IMPLEMENT POSITION CONTROL ADJUSTMENTS

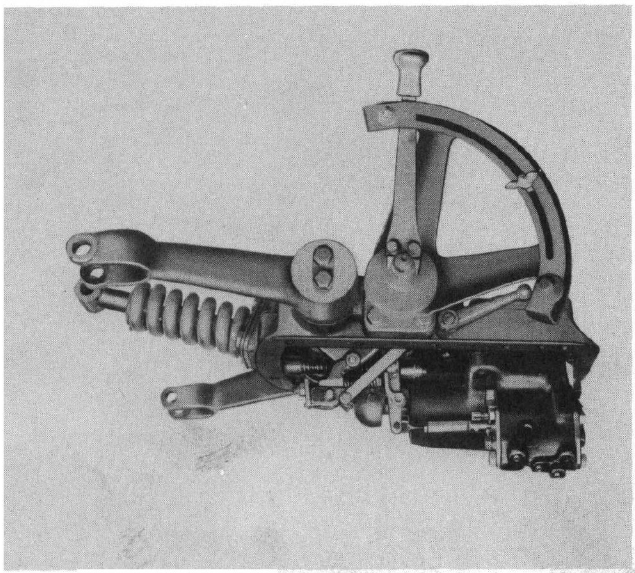


Fig. 11

Constant Draft Control:

1. Turn the control spring yoke until the main control spring is hand-tight.
2. Put the selector lever down, in the constant draft position.
3. Raise the lift arms to the point where the center of the pin hole, at the end of the lift arm, is ½-inch above the plane of the lift cover face. (Figure 12)
4. Raise the touch control lever up to the adjustable stop at the top of the quadrant, making sure that the lobe of the cam on the stop is at its maximum forward position. (Figure 12)

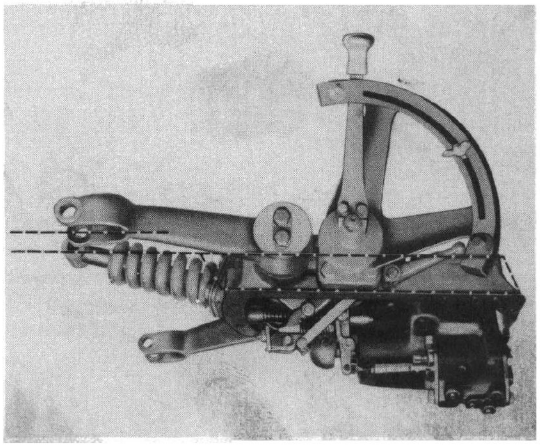


Fig. 12

5. Adjust the gap between the end plate and control valve to .185 or 3/16 inch by adjusting the turnbuckle. Tighten nut to hold. (Figure 13)

NOTE: There must be clearance between the implement position control spring and the boss on the control lever during the draft control adjustment.

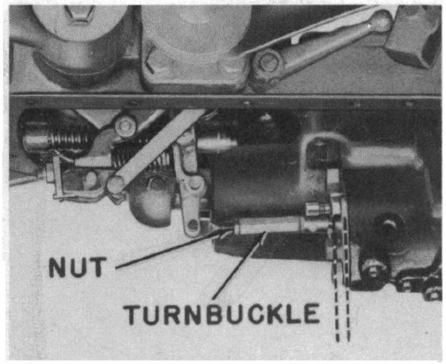


Fig. 13

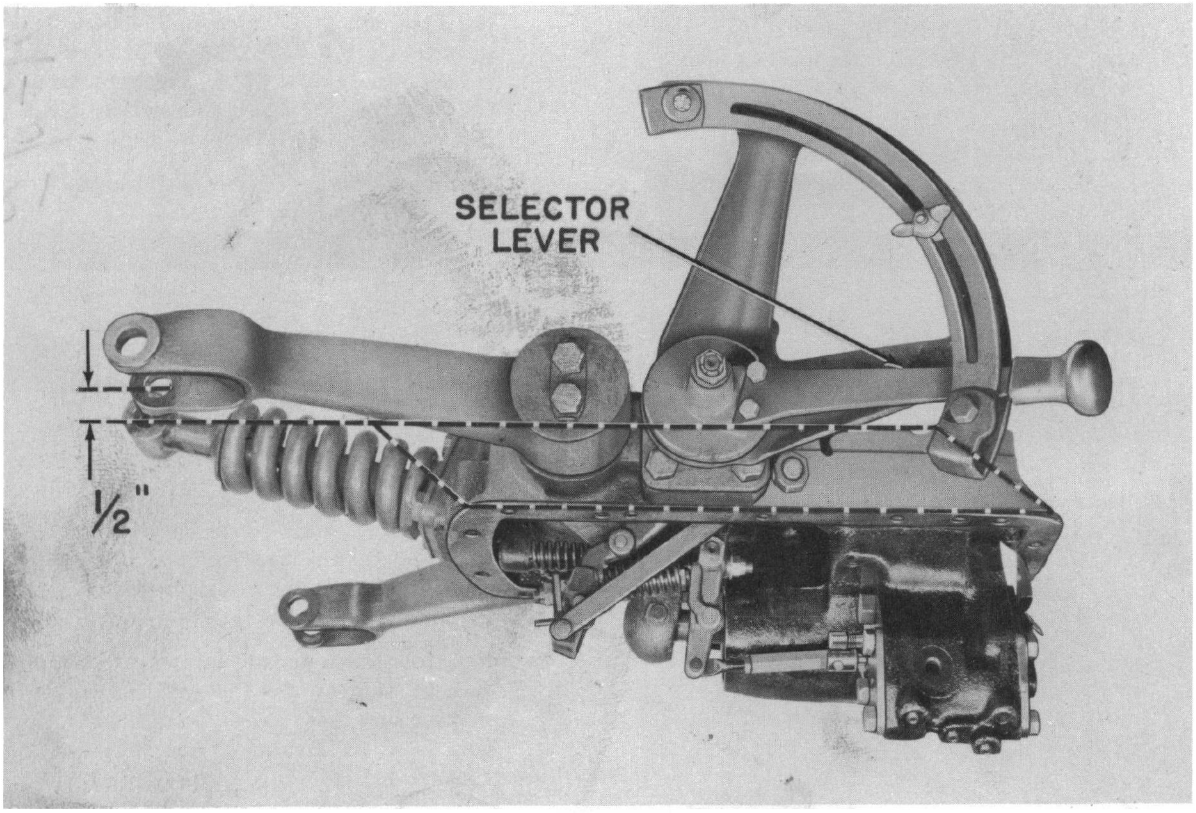


Fig. 14

Implement Position Control:

1. Raise selector lever to its vertical position. (Figure 14)
2. Raise the lift arms to the point where the center of the pin hole at the end of the lift arm is ½-inch above the plane of the lift cover face. (Figure 14)
3. Place the touch control lever down so that the lower edge of the lever is against the stop, at the bottom of the quadrant.
4. Adjust the gap between the plate and control valve to .237 or ¼ inch. This is accomplished by adjusting the length of the implement position control spring. (Figure 15)

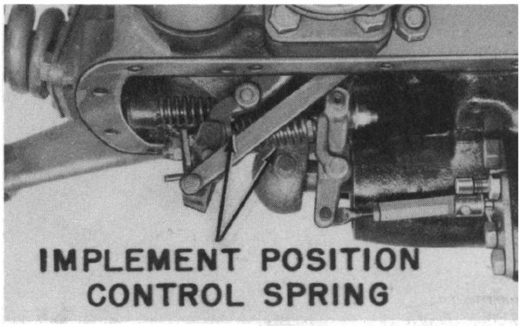


Fig. 15

CHECKING THE ADJUSTMENT

1. Put the lift cover, ram cylinder and valve assembly on the tractor.
2. Put the selector lever down into the constant draft control position.
3. Raise the touch control lever up slowly. If the adjustment has been made correctly, the lift arms will start to raise when the gap between the lobe of the stop and the lever is .43 to .70 or 7/16 to 11/16 inch. (Figure 16)

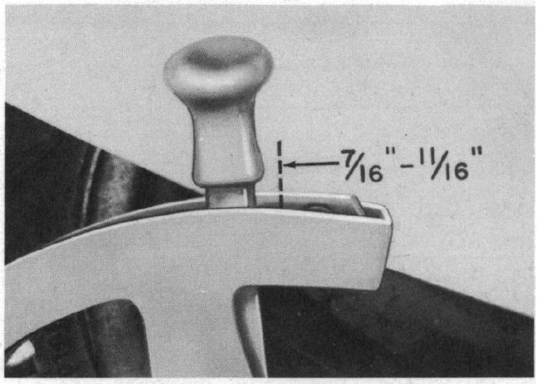


Fig. 16

NAA ENGINE SPECIFICATIONS

CAPACITIES (U.S. MEASURE)								
Fuel Tank	Crankcase	Cooling System	Transmission	Hydraulic System	Differential	Steering Assembly	Belt Pulley	Air Cleaner
11 gal. Total 1 gal. Reserve	5 qts. with Filter Change 4 qts. refill	15 qts.	5 qts.	8 qts.	8 qts.	1 pt.	0.9 pt.	1.3 pt.

ANTI-FREEZE CHART		
Temp.	Ford Anti-Freeze M-1186-A	Ethylene Glycol
20°F	6 pts.	6 pts.
10°F	9 pts.	8 pts.
0°F	11 pts.	11 pts.
-10°F	14 pts.	12 pts.
-20°F	15 pts.	14 pts.
-30°F	17 pts.	15 pts.

TUNE-UP DATA					
Intake & Exhaust Valve Clearance	Firing Order	Breaker Opening	Carb. Idle Adj.	Main Carb. Adj. Needle	Float Setting
.015 (Hot)	1-2-4-3	.024 .026	7/8 - 1 Turns open (Approx.)	1 - 1 1/2 open (Approx.)	.260 - .297 Float top to Body

BEARING PRE-LOADS	in. lbs.
Main Shaft	20-30
Countershaft	15-30
Pinion	12-16
Differential	12-16

TORQUE VALVES	Ft. Lbs.		Ft. Lbs.
Main Bearing Bolts	95-105	Hydraulic Pump Drive Gear Cap Screws	12-16
Connecting Rod Nuts	45-50	Cylinder Block Front Cover Cap Screws	15-18
Connecting Rod Nuts, Locking	Finger Tight + 1/4 Turn	Governor Case Cap Screws	6-10
Cylinder Head Bolts	65-70	Clutch Pressure Plate to Flywheel	15-18
Flywheel to Crankshaft - Cap Screws	75-85	Rocker Arm Shaft Supports to Cylinder Head	45-50
Camshaft Thrust Plate Cap Screws	10-15	Manifold Nuts	40-50
Oil Pan to Cylinder Block	15-18	Oil Pump to Cover Plate	30-35
Oil Filter to Cylinder Block	20-25	Water Pump to Cylinder Block	15-18
Camshaft Gear to Camshaft	45-50	Rocker Arm Cover to Cylinder Head	8-10

NAA ENGINE SPECIFICATIONS (Contd.)

ENGINE CLEARANCES AND DIMENSIONS

	New	Wear Limit
Cylinder:		
Diameter - Bore	3.437 3.438	
Out of Round	.0005	
Taper	.002	
Piston, Aluminum:		
*Skirt Clearance	Top of Skirt To Bore .002 .0034 Bottom of Skirt .001 .0024	
Piston Rings:		
Side Clearance Top	.0015-.0030	
Side Clearance 2nd	.0010-.0025	
Side Clearance Oil	.0015-.0030	
End Gap	.010-.020	
Piston Pin:		
Diameter	.9120-.9123	
**Clearance in Piston	.0001L-.0003L	
***Clearance in Rod	.0001L-.0003L	
Valves:		(Color Code)
Stem Diameter: Intake	.3415-.3420 .3420-.3425	Red Green
Stem Diameter: Exhaust	.3405-.3410 .3410-.3415	Red Green
Clearance in Guide: Intake	.002-.003 S.F.	
Clearance in Guide: Exhaust	.002-.003 S.F.	
Seat Angle	45°	
Hot Lash	.015	
Valve Push Rods	.020 T.I.R.	
Spring Test	54-32 ft. lbs. at 1.821 in.	
	124-140 ft. lbs. at 1.505 in.	10% Loss

	New	Wear Limit
Oil Pump:		
Relief Valve Spring Tension	2# at 1.38 in.	
Drive Shaft to Pump Body Clearance	.0005-.0015	
Drive Gear to Shaft Clearance	.0025-.0045	
Gear to Pump Body Side Clearance		.005 Max.
Valve Tappet:		
Diameter	.4990-.4995	
Clearance in Bore	.0005-.0020	
Connecting Rod Alignment:		
Maximum Twist		.0015 per inch
Maximum Bend		.0005
Crankshaft:		
Journal Diameter:		
Main	2.4974-2.4982	
Crankpin	2.2986-2.2978	
Out of Round:		
Main	.00025	
Crankpin	.00025	
Taper:		
Main	.0005	
Crankpin	.0005	
Bearing Clearance:		
Main	.0007-.0023 S.F.	
Crankpin	.0005-.0021 S.F.	
Connecting Rod Side Clearance	.003-.007	
Crankshaft End Play	.002-.006	
Camshaft:		
Bore Diameter	1.9275-1.9285	
Journal Diameter	1.9255-1.9265	
Bearing Clearance	.0015-.003	
End Play	.002 -.004	
Timing Gear Backlash	.002 -.003	
Rocker Arm Bearing I.D.	.783 -.784	
Rocker Arm Shaft O.D.	.780 -.781	
Rocker Arm to Shaft Clearance		.007

GOVERNED ENGINE SPEEDS

	PTO R.P.M.	Engine R.P.M.	Belt Pulley R.P.M.
Full Load	727	2000	1358
% of Full Load	736	2025	1375
	745	2050	1392
	754	2075	1409
	763	2100	1426
	772	2125	1442
	782	2150	1460
	791	2175	1478
No Load	800	2200	1494

TIRE CHART

Tire Size	Tire Press.	Max. Rec. Tire Load per Wheel (Pounds)	Maximum Calcium Chloride Solutions		
			Pounds Calcium Chloride	Gallons H_2O	Weight of Solution
10-28 - 4 Ply	12-14	1575-1720	116	23	310
4-19 - 4 Ply	20-44	470-750	15	3	40
5:50-16 - 4 Ply	20-32	655-860	25	5	65
6:00-16 - 4 Ply	20-28	750-915	30	6	80
6:00-16 - 6 Ply	20-44	750-1200	30	6	80
6:00-16 - 8 Ply	56-60	1370-1430	30	6	80

* New Piston and Bore - 5-10 lbs. pull on 1/2" x .0015 Feeler Ribbon
New Piston and Used Bore - 5-10 lbs. pull on 1/2" x .002 Feeler Ribbon
Used Piston and New Bore - 5-10 lbs. pull on 1/2" x .002 Feeler Ribbon
Used Piston and Used Bore - 5-10 lbs. pull on 1/2" x .003 Feeler Ribbon

** Thumb Press Pit

*** .001 and .002 Oversize Available

NAA ENGINE SPECIFICATIONS (Contd.)

BATTERY

Part No.	Volts	Plates	Amp. Hrs.
230147	6	13	80

STARTER

Part No.	Amps. No. Load	Amperes Load Cranking Warm Engine
FAC-11001-B	45-60	100-150

Approximate Voltage Drop Around Ignition Circuit With Switch on and Engine Stopped

Circuit	Normal	Max.
Neg. Battery to Terminal Block	0.025	0.2
Terminal Block to Switch Side of Resistor	0.115	0.2
Across Resistor	3.65	
Resistor to Coil	0.025	
Coil to Ground	2.45	

GENERATOR - GENERAL ELECTRICAL SPECIFICATIONS

Part No.	Engine RPM To Test Voltage	Watts	Engine RPM Charge Starts	Maximum Rate		Field Part No.	Field Resistance		Armature Part No.
				Amps.	Engine RPM		Ohms at 70°	Ohms at 140°	
FAC-10000-A	1200	160	625	20	1650	81A-10175-A	3.2	3.8	OA-10005-A

GENERATOR CONTROL

Generator No.	Control No.	Type Control	Cut-in Voltage		Voltage Regulator	
			Minimum	Maximum	Minimum	Maximum
FAC-10000-A	FAG-10505-A	Voltage Regulator and Cutout	6.0	6.6	7.1	7.5

GENERATOR MECHANICAL SPECIFICATIONS

Part No.	Brushes			Generator Replaced in Service by	Pulley Part No.	Pulley Pitch Diameter
	No.	Original Length In.	Wear Limit Length			
FAC-10000-A	2	0.86	.40	FAC-10000-A	FAC-10130-B	3.5

NAA ENGINE SPECIFICATIONS (Contd.)

DISTRIBUTOR MECHANICAL SPECIFICATIONS								
Part No.	Initial Advance Crank-shaft Degrees BTDC	Breaker Arm Spring Tension	Point Spacing	Engine RPM	0-450	1200	2000	Dwell % at Idle
FAC-12127-D	8°	17-20 oz.	.024 - .026	Corresponding Spark Advance (Crankshaft Degrees)	8°	17.5-19.5	29-31	35.5-39%

CONDENSER SPECIFICATIONS					
Part No.	Capacity	Min. Insul. Resis.	Dielectric Strength	Power Factor	Oil Tight at 240°F
7RA12300-C	.21-.25	5 Meg-ohms @210°F	700 V-RMS 60 Cycles 210°F	0.6% @ 60 Cycles 75°F	

COIL				
Primary			Secondary	
Part No.	No. Turns	Ohms Resis.	No. Turns	Ohms Resis.
8BA-12029	240	1.05 @75°F 1.15	21,000	4.00 @75°F

MANIFOLD VACUUM	
In. Hg. (Sea Level)	
RPM	No Load
450	18 in.

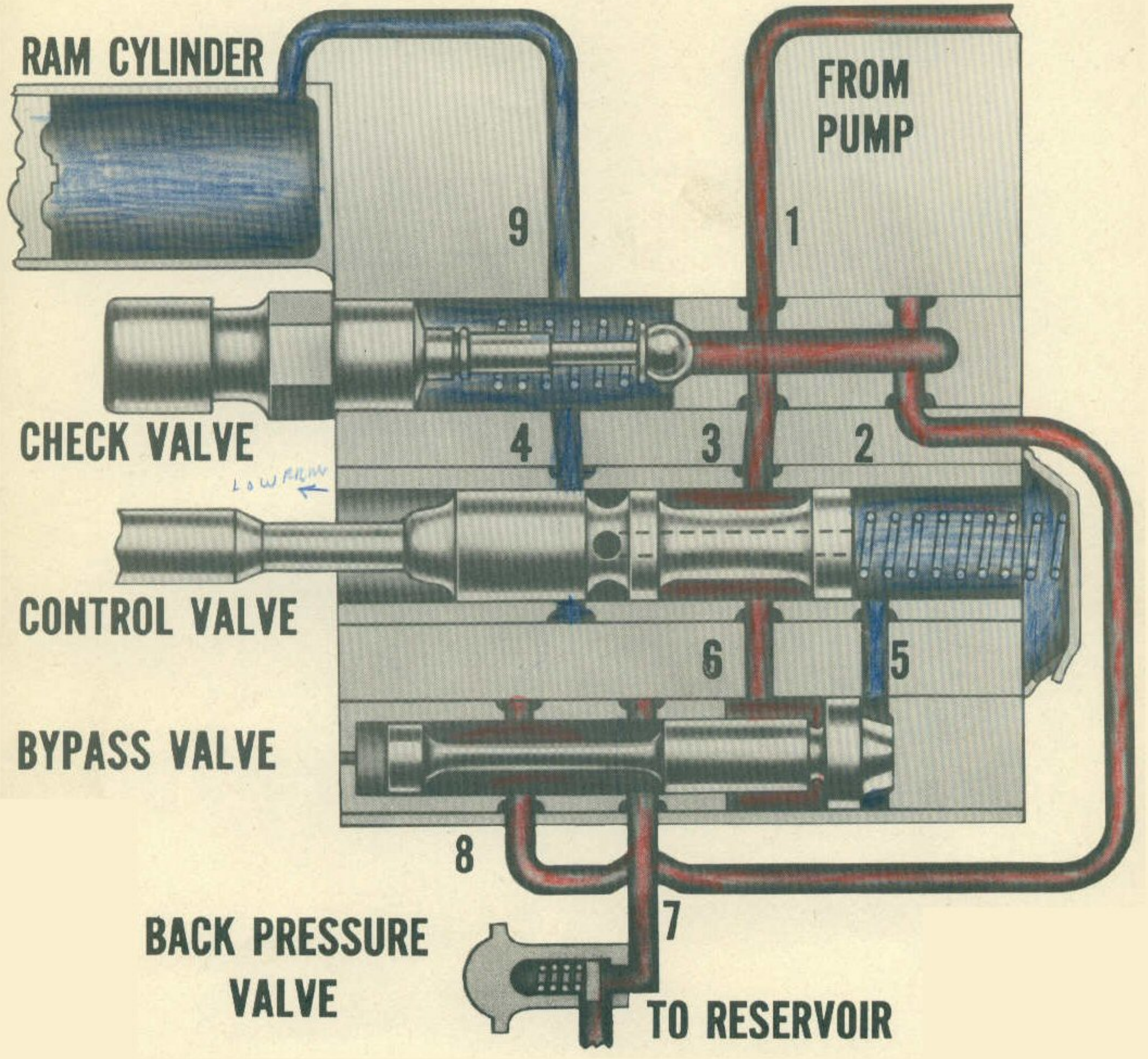
TACHOMETER		
Engine RPM	Idle	Full Throttle
Engine RPM	400-500	2200 No Load

COMPRESSION			
Compression Ratio 6.6-1 Engine Hot			
Compression @ Cranking Speed (all plugs removed engine hot) W.O.T.			
Altitude Sea Level	Cylinder Compression 90#	Barometric Pressure 29.92 Lbs. (Approx.) at 60°F	Min. Press. 80

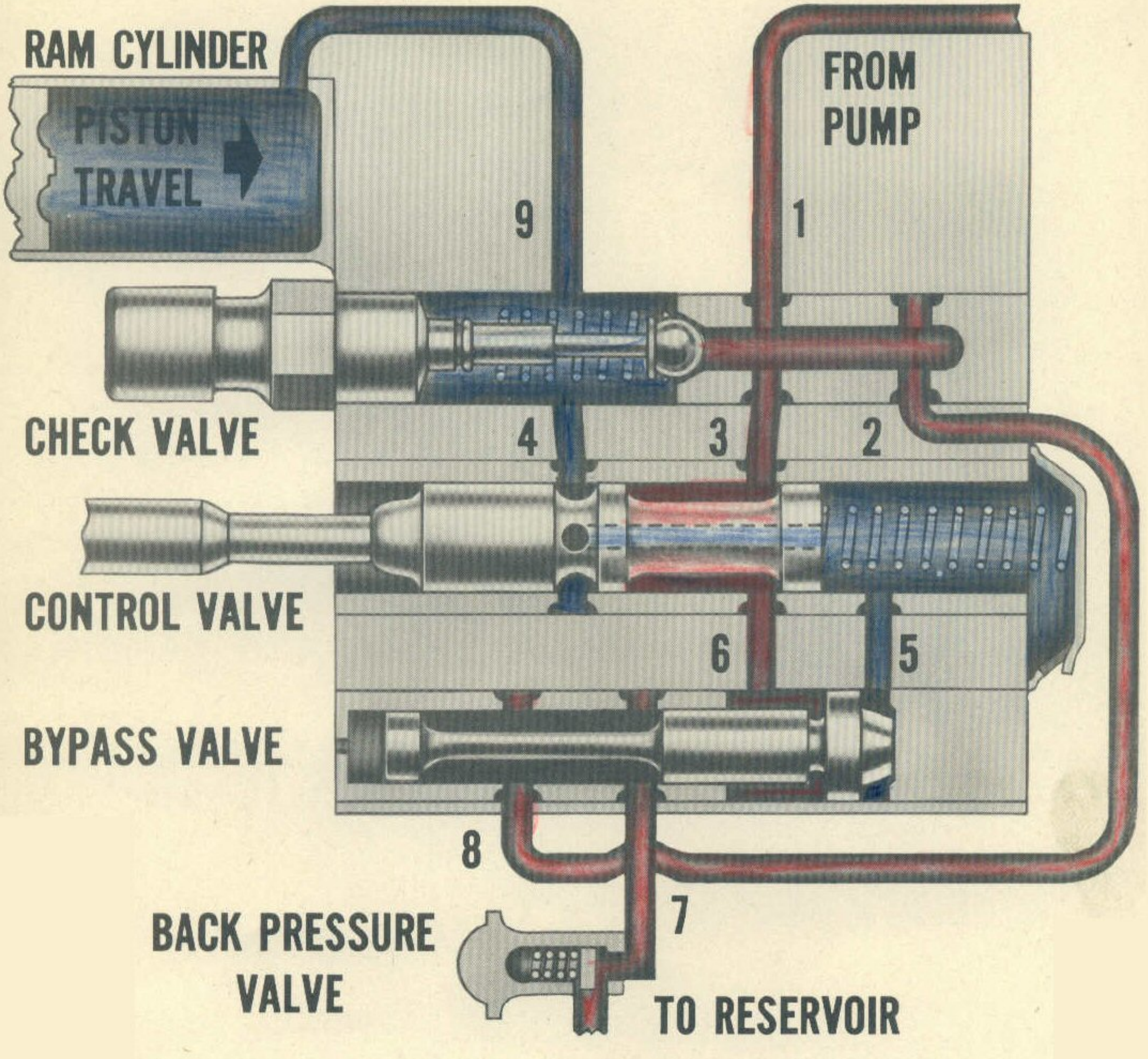
SPARK PLUG				
Part No.	Type	Size	Gap	Torque
9N-12405	H-10	14 MM	0.25 0.28	24-30 Ft. Lbs

Cylinder compression should be within + 10# of specified.
Maximum between adjacent bores must be within 10#.

NEUTRAL POSITION

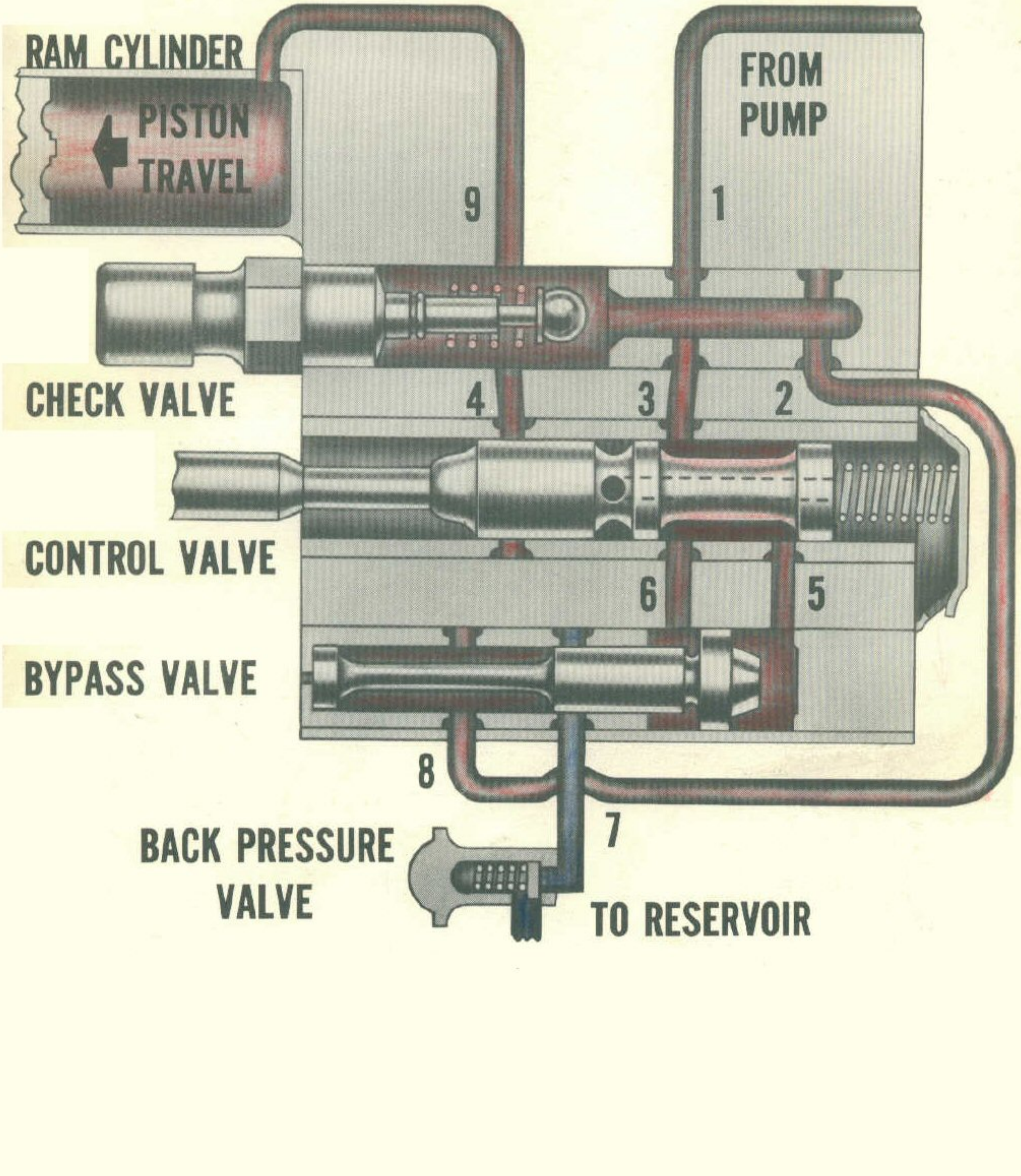


LOWERING POSITION



FORM ED5745—9B

RAISING POSITION



HYDRAULIC TERMS AND DEFINITIONS

Front Side -- That part, surface, or item which faces toward the front of the tractor.

Pressure -- The "push" per square inch of the oil against any or all parts of the hydraulic system. Pressure comes as a result of the resistance the oil encounters in trying to flow through the system: the valves, lines, ports, pistons, etc.

Pressure Drop -- Refers to the loss of pressure in a line or orifice due to the friction of oil flow. Obviously, if we have a small orifice in a line through which a large amount of oil must flow, we would have a drop in pressure at the orifice.

For example, as we see in Figure One, we have a flow of oil in a line (A) of 3 gallons per minute passing through an orifice, which gives a pressure drop of 200 p.s.i. at this rate of flow. The pressure in line (A) would be increased 200 p.s.i. above the assumed working pressure of 1000 p.s.i. in Line (B).

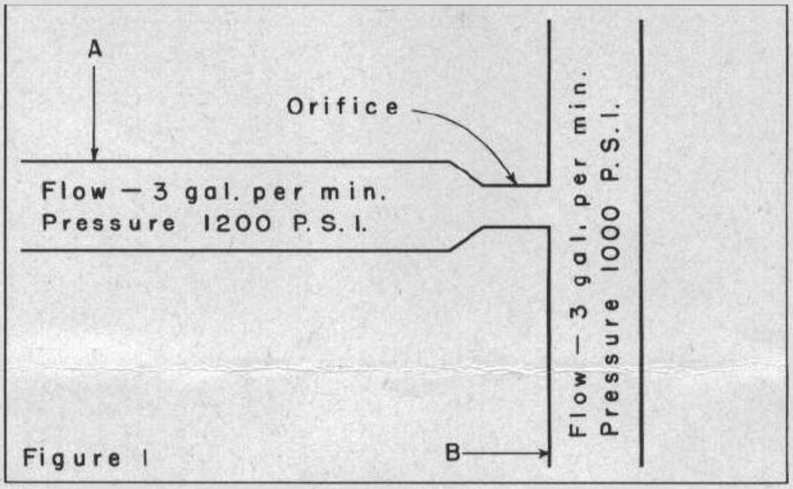


Figure I

For all practical purposes, as long as the flow remains constant at 3 gallons per minute through the orifice, the pressure drop of 200 p.s.i. will remain constant. If, however, the flow were increased, the pressure drop would increase because of more friction or resistance to oil flow in the orifice.

Therefore, we can see that the difference in pressure between lines (A) and (B) as the result of pressure drop is dependent upon the amount of oil flow through the orifice.

Flow -- Refers to the amount of oil discharged from the pump or passing through the system at any point at any given time.

Spring-Loaded Valve -- A valve which uses a spring to keep it positioned.

Check Valve -- The valve which allows the oil to flow in one direction only.

Control Valve -- Operated mechanically and controls direction of the flow of oil in the system in terms of raising, lowering or holding neutral.

Bypass Valve -- Serves a complementary function with the control valve in controlling the flow of oil to the reservoir or to the ram cylinder -- or to whatever external cylinder may be attached directly to the primary system.

Back Pressure Valve -- Restricts the flow of oil to the reservoir, building up just enough pressure in the system to actuate the bypass valve. The back pressure valve in this system operates at about 40 p.s.i.

High Pressure Relief Valve -- Designed and installed for the purpose of protecting the hydraulic system against damage resulting from pressures above what the system is designed to handle with safety. The relief valve in this system is set for 2000 p.s.i.

Safety Valve -- Designed and installed for the purpose of protecting the ram cylinder circuit against shock loads.